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U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 15

[Actual date of publication, August 8, 1899.]

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REVISION OF THE JUMPING MICE OF THE GENUS ZAPUS

BY

EDWARD A. PREBLE
ASSISTANT IN BIOLOGICAL SURVEY

Prepared under the direction of
Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., June 15, 1899.

SIR: I have the honor to transmit herewith for publication, as No. 15 of North American Fauna, a 'Revision of the Jumping Mice of the Genus *Zapus*,' by Edward A. Preble, assistant in the Biological Survey.

Respectfully,

T. S. PALMER,
Acting Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

J. H. Riley

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No. 15. NORTH AMERICAN FAUNA. August, 1899.

REVISION OF THE JUMPING MICE OF THE GENUS ZAPUS.

By EDWARD A. PREBLE.

INTRODUCTION.

History and material.—The Jumping Mice of North America early attracted the attention of naturalists, but their true status and relationships long remained in obscurity. The first reference to any of the species seems to have been made by Thomas Pennant, in the latter part of the last century, who mentioned the animal under the name of the 'Long-legged Mouse of Hudson's Bay.' In 1780 Zimmermann, basing his description on that of Pennant, and supposing the animal to be congeneric with the jerboas of the Old World, named it *Dipus hudsonius*. Subsequent authors, recognizing the inapplicability of *Dipus*, referred the species successively to *Gerbillus*, *Meriones*, and *Jaculus*, until finally Dr. Elliott Coues, in 1875, after showing that all the generic names previously used were untenable, proposed *Zapus*.

Previous to 1857 a number of specific names were used for members of this genus (see pp. 10–13), but were applied mainly to specimens from the eastern United States and Canada. Suffice it to say that Baird, in 1857, and Coues, in 1877, recognized but one species, having a range nearly coincident with the present geographic distribution of the genus in North America. This resulted mainly from two causes—poor quality of existing material and the prevailing tendency of the times to lump distinct species having a superficial resemblance to one another. The material consisted mainly of poorly preserved alcoholic specimens, or skins badly made (in most cases with the skulls inside), and without satisfactory measurements. The characters distinguishing the species, therefore, were not apparent or were considered as being due merely to individual variation. In failing to examine skulls, both Baird and Coues referred specimens of the animal since described as

Zapus insignis to *Z. hudsonius*, though *insignis* has a different number of teeth and is now considered subgenerically distinct from the latter. Under the improved methods of collecting and preserving mammals now in vogue large series of well-prepared specimens have been brought together during the past few years, and several new forms have been described, mainly from the west and northwest.

The following revision of the genus *Zapus* is based on a study of more than 900 specimens, mainly in the collections of the Biological Survey of the U. S. Department of Agriculture, the U. S. National Museum, and several private individuals.[1] To the custodians and owners of these collections my thanks are cordially extended. For kind assistance and advice my thanks are also especially due to Dr. C. Hart Merriam, Dr. T. S. Palmer, and Mr. Gerrit S. Miller, jr. Through the courtesy of Mr. Miller I have had an opportunity of examining the types of *Zapus setchuanus* Pousargues, temporarily placed in his hands for comparison, and am thus able to present a complete account of the genus, including a description of this very interesting Asiatic species, the only one known from the Old World.

The National Museum collection of *Zapus*, though not extensive, contains many specimens of unusual interest from widely separated localities; that of the Biological Survey is especially rich in western specimens; and those of Miller and Bangs contain good series of eastern species. These collections, comprising many large suites of well-prepared skins, nearly all accompanied by perfect skulls and by measurements taken in the flesh, have afforded facilities for comparison never before enjoyed. Much additional material is needed, however, before certain questions concerning relationship and seasonal variation can be satisfactorily settled.

Distribution.—Zapus is a Boreal genus, and, with the exception of a single species, is confined to North America. The exact northern limits of its range are not well known, but are indicated by specimens from Hamilton Inlet, Labrador; Fort Churchill, on Hudson Bay; Fort Rae, on Great Slave Lake; and the Yukon River (probably Fort Yukon, just below the Arctic Circle). Southward it extends as far as Raleigh, N. C.; Wheeling, W. Va.; Jackson County, Mo.; Santa Fe, N. Mex.; and Kern River, California. Within the region thus roughly outlined there are probably no large areas where at least one member of the genus is not found. In regions where there is little or no woodland its distribution is more or less local, and is confined almost exclusively to the borders of streams. Of course, the arid deserts of the West do not offer a congenial environment.

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[1] These specimens are as follows: Biological Survey, 378; U. S. National Museum, 85; Merriam Collection, 60; Bangs Collection, 132; Miller Collection, 200; and a few from each of the following collections, American Museum of Natural History, New York; Academy of Natural Sciences, Philadelphia; Carnegie Museum, Pittsburg, Pa.; Field Columbian Museum, Chicago; and the collections of Samuel N. Rhoads and Charles F. Batchelder.

Very little is known of the geological history of *Zapus*, except that the genus dates back to the Postpliocene. In 1871 Prof. E. D. Cope recorded a mandibular ramus with incisor and second molar of a Jumping Mouse from the Port Kennedy Bone Cave in Pennsylvania.[1] On account of lack of recent specimens for direct comparison he was somewhat in doubt as to the specific identity of the remains, but referred them to *Jaculus* (= *Zapus*) *hudsonius*.[2]

External characters.—The external and cranial characters of *Zapus* have been so exhaustively treated by Baird, Coues, and others that a brief reference to them here will be sufficient. The body is considerably enlarged posteriorly, the hind legs and tail greatly developed, the forelegs rather short, and the ears somewhat longer than the surrounding fur. All the species agree closely in color and markings. A broad dorsal stripe of some shade of yellowish brown, quite thickly flecked with black-tipped hairs, is bordered by a slightly narrower lateral stripe of a lighter color and usually with less black. The fur of the entire upper parts is uniform plumbeous at base, only the tips of the hairs affecting the external appearance of the animal. Between the darker color of the sides and the white of the lower parts is a narrow stripe of clear yellowish orange, unmixed with black, and with the base of the hairs white. The lower parts are white, sometimes suffused with the color of the sides, and one species, *Z. setchuanus*, from China, has a well-defined brown ventral stripe. The tail is very long, usually about 60 per cent of the total length, and more or less distinctly bicolor, brownish above and whitish below. It is thinly covered with short hairs, which are longer on the terminal part and form a short pencil. In two of the three subgenera the tail is conspicuously tipped with white. The spring and early fall pelages differ noticeably, except in members of the subgenus *Napæozapus*, the bright color of the spring and early summer pelage becoming duller in the fall, and the dark dorsal area partially obliterated. In some species, however, the dorsal area is darker and more sharply defined in late summer and early fall than in spring and early summer.

The teats are normally 8, and arranged in pairs at regular intervals. The pectoral pair is situated just back of the forelegs, the inguinal pair far back at the base of the thighs, and the remaining pairs between. Sometimes the anterior or posterior pair remains undeveloped.

Habits.—In general but one species occurs in a given locality, but *Zapus hudsonius*, which has the widest range of all, seems to be always present throughout the range of the subgenus *Napæozapus*, the members of which are almost invariably found in deep woods near streams. All the other species delight in meadows, shrubby fields, and thickets along the edges of woods, and show a marked preference for moist locations. During the summer Jumping Mice are often seen in meadows and fields, and are more readily detected during the haying season than at other times, when they are driven from their hiding places while the grass is being cut. When disturbed they move off by a series of frog like leaps, and often remain motionless after a jump or two, especially when frightened from a nest. In leaping they are greatly assisted by their long tails, which aid in preserving their balance as in the case of other animals similarly endowed. If, by any accident, a portion of the tail is lost, the power of balancing is greatly impaired, and the animal, if startled, seems unable to pursue a direct course because of failure to land properly on its feet. Some of the earlier writers ascribe to the animal the power of leaping 4 or 5 yards. Such statements are probably exaggerated, but it is certain that *Zapus* does possess remarkable leaping powers, and when disturbed will jump 6 or 8 feet, and under some circumstances perhaps much farther. In their chosen haunts these mice do not follow beaten paths or runways like many small mammals, notably meadow mice, but seem to wander rather indiscriminately, availing themselves to some extent of natural pathways or open places.

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[1] Preliminary report on the Vertebrata discovered in the Port Kennedy Bone Cave <Proc. Am. Philos. Soc., XII, p. 86, 1871.

Vertebrate Remains from Port Kennedy Bone Deposit <Journ. Acad. Nat. Sci. Phila., 2d ser., XI, p. 200, 1899.

[2] Spelled *hudsonianus* by Zittel, Handbuch der Palæontologie, IV, p. 527, 1893.

The birth of the young (five or six in number) which occurs in a nest, ordinarily underground but sometimes placed in a hollow tree, usually takes place in May or June. Sometimes, however, it occurs as late as September; from which it seems probable that a second litter is raised, or that the breeding season continues throughout the summer. Three specimens obtained by my brother at Wilmington, Mass., September 25, 1897, which with their parents were turned up by a plow, were so young that the posterior upper molars had just appeared.

During the latter part of summer *Zapus* makes a globular nest of grass about 4 inches in diameter, with a small entrance at the side. All that I have seen were on the ground in meadows among thick grass or small bushes. One that I examined was made entirely of the straight narrow leaves of grass, and was a very beautiful little home; but though seemingly compact, it was so frail that it was impossible to preserve it. These nests are usually occupied by two individuals, presumably a pair, and seem to be used only at the close of the breeding season.

The hibernation of *Zapus* has been frequently noticed and several interesting articles have appeared mainly on this habit.[1] All the species, so far as known, hibernate during winter, though in one, at least, hibernation is not always complete—that is, individuals may awake and come out during warm intervals, after the manner of the common skunk. Dr. Merriam mentions having seen Jumping Mice abroad in northern New York on several occasions during the unusually mild winter of 1881–82. Messrs. H. H. and C. S. Brimley report that they have no positive evidence of the hibernation of *Zapus hudsonius americanus* at Raleigh, N. C., although they add that the animal is too rare to enable them to find out much about it. Hibernation varies with the locality, but usually begins about the time of the first heavy frosts and lasts until spring. The fall pelage is usually assumed and the animals become exceedingly fat before entering winter quarters. Although they often lay up stores of food in nests or burrows during summer, it is not known that they use this food during winter. The animals are generally found singly (sometimes in pairs) in nests in holes at a depth varying from a few inches to 2 or 3 feet below the surface. They lie rolled up like a ball with the feet close together and tail curled about them. If removed from the nest and subjected to a moderate degree of heat they revive and in the course of a few hours move about freely, but generally resume their lethargic state if again exposed to cold. The pulse and respiration are very slow.

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[1] Davies, Trans. Linn. Soc. London, IV, p. 155, 1798; Barton, Trans. Am. Philos. Soc., VI, p. 143, 1804; Tenney, Am. Nat., VI, p. 330, 1872.

Hibernation sometimes takes place in a nest above ground. Dr. A. K. Fisher tells me that some years ago a *Zapus* was brought to him at Lake George, New York, which some men at work in the woods had found hibernating in an elaborate nest of grass and moss, exposed by moving a log. This nest was destroyed, but when the animal was given material it constructed another, in which it resumed its interrupted sleep. It was occasionally awakened, and observations were taken on its weight, respiration, and heart beats, after which it would relapse into its state of lethargy.

NOMENCLATURE.

Five generic and 30 specific and subspecific names have been applied to various forms of Jumping Mice now included in the genus *Zapus*. In order to discuss the different species and subspecies intelligently it becomes necessary to separately consider each of these names, which may be taken up alphabetically.

GENERIC NAMES.

Dipus Zimmermann, Geog. Geschichte des Menschen u. vierfüssigen Thiere, II, p. 358, **1780**. The original description of the genus *Dipus* included six species: *D. jaculus*, *D. sagitta*, *Yerbua capensis* (=*Mus cafer*), *D. longipes*, *D. tamaricinus* and *D. hudsonius*. The name was subsequently restricted to the Old World jerboas.

Gerbillus Desmarest, Nouv. Dict. d'Hist. Nat., XXIV, p. 222, **1804**. A genus of Old World rodents allied to *Meriones*. Four nominal species of American Jumping Mice were referred to this genus by Rafinesque in 'Précis des Découv. somiologiques' (p. 14, 1814), and Am. Monthly Magazine (III, p. 446, Oct., 1818).

Meriones Illiger, Prod. Syst. Mamm. et Avium, p. 82, **1811**. The name was originally proposed by Illiger for a group including *Dipus tamaricinus* and *D. meridianus*. Cuvier apparently proposed it independently, twelve years later, for the American Jumping Mouse (Dents des Mamm., pp. 187, 256, 1823).

Jaculus Erxleben, Syst. Nat., p. 404, 1777. A genus of Old World jerboas. The name was first used for North American species by Wagler (Nat. Syst. Amphibien, p. 23, 1830).

Zapus Coues, Bull. U. S. Geol. Surv. Terr., I, 2d ser., No. 5, p. 253, 1875. The first tenable generic name based on a North American Jumping Mouse.

SPECIFIC AND SUBSPECIFIC NAMES.

Acadicus (Meriones) Dawson, Edinburgh New Philos. Journ., new series, III, p. 2, 1856. Dawson, after unmistakably referring the animal since described as *Zapus insignis* to the *Meriones labradorius* of Richardson's Fauna Boreali-Americana (i. e., *Z. hudsonius*), goes on to describe *Z. hudsonius* from Nova Scotia, calling it provisionally *Meriones acadicus.*

Alascensis (Zapus) Merriam, Proc. Biol. Soc. Wash., XI, p. 223, July 15, 1897. Dr. C. Hart Merriam has described a subspecies of *Z. hudsonius* under this name, from specimens collected at Yakutat Bay, Alaska.

Alleni (Zapus) Elliot, Field Columbian Mus., Pub. 27, Zool. Ser., I, No. 10, pp. 212–213, March, 1898. Under this name Mr. D. G. Elliot described the form of *Zapus* inhabiting the Sierra Nevada in California.

Americanus (Dipus) Barton, Trans. Am. Philos. Soc., IV, No. XII, p. 115, 1799. Under this name Benjamin Smith Barton described specimens from the vicinity of Philadelphia, Pa. Later (ibid, VI, 1804) he discussed the habit of hibernation and presented a figure of the animal. Mr. C. F. Batchelder has recently revived *americanus* for the form of *Z. hudsonius* inhabiting the Upper Austral zone in the Eastern States. (Proc. New Eng. Zool. Club, I, p. 6, 1899.)

Brachyurus (Gerbillus) 'Rafinesque.' A name referred to by Fischer (Syn. Mamm., p. 340, 1829) without reference, and included in the synonomy of *Zapus* by Coues (Mon. N. Am. Rodentia, p. 468, 1877). I have been unable to find the original reference, but the inapplicability of the name is self-evident.

Canadensis (Dipus) Davies, Trans. Linn. Soc. London, IV, p. 157, 1798. Maj. Gen. Thomas Davies described specimens which he had procured in the vicinity of Quebec, Canada. He undoubtedly referred to an animal of the *hudsonius* type, and as specimens from that region do not deserve separation from the typical form, the name becomes a synonym of *hudsonius.*

Daviesii (Gerbillus) Rafinesque, 'Precis des Découv. somiologiques, p. 14, 1814.' Rafinesque is said to have renamed *Dipus canadensis* after its describer.

Hardyi (Zapus) Batchelder, Proc. New. Eng. Zool. Club, I, p. 5, February 8, 1899. Mr. C. F. Batchelder has recently applied this name to specimens from Mount Desert Island, Maine. From a careful study of the material at present accessible, I can find no characters of importance to separate this form from *hudsonius* as here restricted.

Hudsonius (**Dipus**) Zimmermann, Geog. Geschichte des Menschen u. vierfüssigen Thiere, II, p. 358, 1780. This is the first specific name proposed for any species of Jumping Mouse in America, and undoubtedly refers to the common eastern species which has so long borne the name. It is the only species thus far known to occur about Hudson Bay—the locality of Pennant's 'long-legged mouse,' to which Zimmermann referred.

Imperator (**Zapus**) Elliot, Field Columbian Mus., Pub. 30, Zool. Ser., I, No. 11, p. 228, February 1, 1899. Mr. D. G. Elliot has recently described a *Zapus* from the Olympic Mountains of Washington, but specimens from that region not being considered separable from typical *Z. trinotatus*, the name becomes a synonym.

Insignis (**Zapus**) Miller, Am. Naturalist, XXV, p. 472, August, 1891. Mr. Gerrit S. Miller, jr., described the species erroneously referred to *M. labradorius* (*Z. hudsonius*) by Dawson, from specimens collected on the Restigouche River, New Brunswick.

Labradorius (**Dipus**) Kerr, Animal Kingdom, p. 276, 1792. Based on the 'Labradore Jerboid Rat' of Pennant's History of Quadrupeds, 1781. Kerr says, "Inhabits Hudson's Bay and Labradore. This species was sent over from Hudson's Bay by Mr. Graham." Although Labrador is mentioned in the habitat of the species, the specimen came from Hudson Bay, and consequently the name should be restricted to the animal from that region, thus becoming a synonym of *hudsonius*.

Ladas (**Zapus**) Bangs, Proc. New Eng. Zool. Club, I, p. 10, February 28, 1899. Under this name Mr. Outram Bangs has described, as a subspecies, the form of *hudsonius* inhabiting the Labrador Peninsula.

Leonurus (**Gerbillus**) Rafinesque, Am. Monthly Mag., III, p. 446, October, 1818. From the description—"body fallow, ears very long, white inside, tail as long as body, black with a fallow tuft at end, length 6 inches, body 3"—the animal is plainly not referable to *Zapus*.

Longipes (**Mus**) Zimmermann, in Pennant's Arkt. Zool. I, p. 131, 1787.* Zimmermann erroneously identified a Jumping Mouse in spirits, sent from Hudson Bay by Mr. Graham, as *Mus longipes* of Pallas, an animal from the deserts about the Caspian Sea.

Macrourus (**Gerbillus**) 'Rafinesque,' a name referred to by Fischer (Syn. Mamm., p. 340, 1829), without reference, and included in the synonomy of *Zapus* by Dr. Coues (Mon. N. Am. Rodentia, p. 468, 1877). I have been unable to find the original reference.

Megalops (**Gerbillus**) Rafinesque, Am. Monthly Mag., III, p. 446, October, 1818. This animal he describes as follows: "Body gray, belly white." * * * "Total length 5 inches, body only 2. From the barrens of Kentucky." This can not apply to any species of Jumping Mouse.

Mellivorus (**Dipus**) Barton, Trans. Am. Philos. Soc., VI, p. 143, 1804.

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*Fide Coues, Mon. N. Am. Rodentia, p. 467, 1877. I have not seen this edition of Pennant.

This name occurs incidentally in the text, being applied to a supposed new species, with remarks on its reputed habit of passing the winter in beehives and living on the honey.

Microcephalus (**Meriones**) Harlan, Proc. Zool. Soc. London, p. 1, **1839.** Under this name Dr. Harlan described specimens from the vicinity of Philadelphia, Pa. The name, being antedated by *americanus* Barton, becomes a synonym.

Montanus (**Zapus**) Merriam, Proc. Biol. Soc. Wash., XI, p. 104, April 26, **1897.** Dr. C. Hart Merriam described the form inhabiting the Cascade Range in Oregon, under the name *Zapus trinotatus montanus*, but the characters seem to warrant its recognition as a full species.

Nemoralis (**Meriones**) Geoffroy St. Hilaire, Dict. Classique d'Hist. Nat., VII, p. 323, Fev., **1825.** Under this name Geoffroy published a careful description of two specimens (without locality), in the Museum d'Histoire Naturelle of Paris, which were figured by F. Cuvier and served as the basis of Cuvier's genus *Meriones*. There is nothing in the description of *nemoralis* that gives any clue to the specific identity of the animal.

Niger (**Gerbillus**) Rafinesque, Am. Monthly Mag., IV, p. 106, December, **1818.** A *nomen nudum* used by Rafinesque in an article entitled 'General Account of the Discoveries made in the Zoology of the Western States.'

Pacificus (**Zapus**) Merriam, Proc. Biol. Soc. Wash., XI, p. 104, April 26, **1897.** Under this name Dr. C. Hart Merriam described a form represented in the Biological Survey collection by specimens collected in upper Rogue River Valley, Oregon.

Princeps (**Zapus**) Allen, Bull. Am. Mus. Nat. Hist., V, pp. 71–73, April 28, **1893.** Dr. J. A. Allen described under this name a large species from Florida, La Plata County, Colo., which proves to be a very distinct form inhabiting the Rocky Mountain region of the United States.

Saltator (**Zapus**) Allen, Bull. Am. Mus. Nat. Hist., N. Y., XII, p. 3, March 4, **1899.** Dr. J. A. Allen has recently described under this name a well-marked form inhabiting northern British Columbia and the adjacent region.

Setchuanus (**Zapus**) Pousargues, Ann. Sci. Nat., 8e sér., I, No. 4, p. 220, Avril, **1896.** The only name based on the single Old World species of *Zapus*.

Soricinus (**Gerbillus**) Rafinesque, 'Précis des Découv. somiologiques p. 14, **1814.**' I have not seen the original reference.

Sylvaticus (**Gerbillus**) Rafinesque, Am. Monthly Mag., III, p. 354, September, **1818.** A *nomen nudum* used by Rafinesque in a letter addressed to "Samuel L. Mitchill, president, and the other members of the Lyceum of Natural History, * * * dated at Louisville, Falls of Ohio, 20 July, 1818."

Tenellus (**Zapus**) Merriam, Proc. Biol. Soc. Wash., XI, p. 103, April 26, **1897.** Under this name Dr. C. Hart Merriam has described a form from Kamloops, British Columbia.

Trinotatus (**Zapus**) Rhoads, Proc. Acad. Nat. Sci., Phila., 1849, p. 421 (January 15, **1895**). Under this name Mr. S. N. Rhoads described, from specimens taken on Lulu Island, near the mouth of Fraser River, a well marked form inhabiting the Pacific coast region from Fraser River, British Columbia, to Humboldt Bay, Calif.

Genus ZAPUS Coues.

Dipus Zimmermann, Geog. Geschichte d. Menschen u. vierfüssigen Thiere, II, p. 358, 1780.

Gerbillus Rafinesque, 'Précis des Découv. somiologiques, p. 14, 1814'. (Not *Gerbillus* Desmarest, 1804.)

Meriones F. Cuvier, Dents des Mamm., pp. 187, 256, 1823. (Not *Meriones* Illiger, 1811.)

Jaculus Wagler, Nat. Syst. Amphibien, p. 23, 1830. (Not *Jaculus* Erxleben, 1777.)

Zapus Coues, Bull. U. S. Geol. Surv. Terr., I, 2d ser., No. 5, p. 253, 1875.

Characters.—Skull not massive; brain case rather high and rounded; antorbital foramen large and oval; zygomata not widely spreading, broadly expanded anteriorly where the malar extends upward to the lachrymal. Teeth 16 or 18 (upper premolar present or wanting); enamel much folded; upper incisors compressed, much curved, deeply sulcate, and deep orange.

Body enlarged posteriorly; hind legs and tail greatly developed, the latter much exceeding length of head and body. Tail slender, uniformly tapering. Toes of hind foot five, each with separate metatarsal. Upper parts ochraceous; median dorsal band dark. Under parts white (often suffused with ochraceous); one species with brown ventral stripe.

KEY TO THE SUBGENERA OF ZAPUS.

Premolar present:
  Enamel folds closely crowded; tail not tipped with white; ears rather long; lower parts white or ochraceous .... *Zapus*
  Enamel folds not crowded; tail tipped with white; ears rather short; lower parts white with brown ventral stripe .... *Eozapus*
Premolar absent:
  Enamel folds closely crowded; tail tipped with white; ears rather long; lower parts white .... *Napæozapus*

LIST OF SPECIES AND SUBSPECIES, WITH TYPE LOCALITIES.

Subgenus *Zapus*.

Zapus alascensis.	Yakutat, Alaska.
alleni.	Pyramid Peak, Lake Tahoe, California.
americanus.	Philadelphia, Pennsylvania.
campestris nob.	Bear Lodge Mountains, Wyoming.
hudsonius.	Hudson Bay.
ladas.	Rigoulette, Hamilton Inlet, Labrador.
major nob.	Warner Mountains, Oregon.
minor nob.	Wingard, Saskatchewan.
montanus.	Crater Lake, Mount Mazama, Oregon.
nevadensis nob.	Ruby Mountains, Nevada.
orarius nob.	Point Reyes, California.
oregonus nob.	Elgin, Oregon.
pacificus.	Prospect, Rogue River Valley, Oregon.
princeps.	Florida, La Plata County, Colorado.
saltator.	Telegraph Creek, Northwest Territory.
tenellus.	Kamloops, British Columbia.
trinotatus.	Lulu Island (mouth Fraser River), British Columbia.

Subgenus *Napæozapus.*

abietorum nob.	Peninsula Harbor, Ontario.
insignis.	Restigouche River, New Brunswick.
roanensis nob.	Magnetic City, Roan Mountain, North Carolina.

Subgenus *Eozapus.*

setchuanus.	Ta-tsien-lou, Szechuen, China.

Subgenus ZAPUS Coues.

Type Zapus hudsonius (Zimmermann), from Hudson Bay.

Subgeneric characters.—Teeth: $i. \frac{1-1}{1-1}, p. \frac{1-1}{0-0}, m. \frac{3-3}{3-3} = 18$. Upper premolar very small, nearly cylindrical; anterior upper molar large, broadly oval; *m* 2 similar, but noticeably smaller; *m* 3 considerably smaller and nearly circular. Lower molars similar in shape and relative size (fig. 1). Enamel folds closely crowded. Interorbital constriction of medium width; frontal region moderately swollen; brain case rather high; rostrum slender and somewhat attenuated.

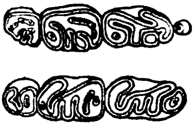

FIG. 1.—Molar teeth of *Zapus hudsonius* from Tower, Minnesota (No. 72695, U. S. Nat. Mus.) × 6.

Upper parts as in entire genus; lower parts white, sometimes suffused with color of sides; tail more or less distinctly bicolor, normally without white tip.

KEY TO SPECIES OF THE SUBGENUS ZAPUS.

Lower parts much suffused with color of sides .... *orarius.*
Lower parts not much suffused with color of sides.
  Size, large; hind foot usually more than 32 mm.
    Ears never conspicuously bordered with whitish.
      Larger; pencil of tail never normally white; lower parts often suffused with ochraceous .... *trinotatus.*
      Smaller; pencil of tail usually white; lower parts never suffused with ochraceous.. *alleni.*
    Ears usually conspicuously bordered with whitish.
      Sides light ochraceous buff.................................. *nevadensis.*
      Sides not light ochraceous buff.
        Skull narrow; incisive foramina very large.................... *saltator.*
        Skull broad; incisive foramina not very large.
          Hind foot about 35 mm.. *major.*
          Hind foot about 32 to 34 mm.
            Incisive foramina broad posteriorly .... *oregonus.*
            Incisive foramina narrow posteriorly.................. *princeps.*
  Size medium or small; hind foot usually below 32 mm.
    Size medium; hind foot 30 to 32 mm.; total length of adults more than 215 mm.
      Skull rather heavy; brain case broad; incisive foramina rather large.
        Dorsal area not very distinct .... *pacificus.*
        Dorsal area distinct.
          Rostrum considerably deflected.............................. *minor.*
          Rostrum not much deflected .... *montanus.*

Skull rather light; brain case narrow; incisive foramina small.
  Coloration dark and dull.
    Larger; basilar length of skull usually more than 18 mm. *alascensis.*
    Smaller; basilar length of skull usually under 17.5 mm.. *tenellus.*
  Coloration not dark and dull.
    Dorsal area very much flecked with color of sides; fall pelage with dorsal area nearly black .... *campestris.*
    Dorsal area not much flecked with color of sides; fall pelage with dorsal area not very dark.
      Larger; hind foot about 32 mm.; tail usually more than 140 mm..... .... *ladas.*
      Smaller; hind foot usually 30 or 31 mm.; tail usually below 135 mm .... *hudsonius.*
Size small; hind foot usually below 30 mm.; total length of adults usually under 215 mm.. *americanus.*

ZAPUS HUDSONIUS (Zimmermann). Hudson Bay Jumping Mouse.

(Pl. I, figs. 3, 3a.)

1780. *Dipus hudsonius* Zimmermann, Geog. Geschichte d. Menschen u. vierfüssigen Thiere, II, p. 358.
1792. *Dipus labradorius* Kerr, Animal Kingdom, p. 276 (based on the 'Labradore Jerboid Rat of Pennant').[1]
1798. *Dipus canadensis* Davies, Trans. Linn. Soc. London, IV, p. 157.
1822. *Gerbillus canadensis* Desmarest, Mammalogie, II, p. 321.
1825. *Gerbillus labradorius* Harlan, Fauna Am., p. 157 (in part).
1829. *Meriones labradorius* Richardson, Fauna Boreali-Americana, I, p. 144. (Not *M. labradorius* Dawson, 1856.)
1830. *Jaculus americanus* Wagler, Nat. Syst. Amphibien, p. 23.
1839. *Meriones microcephalus* Harlan, Proc. Zool. Soc. London, 1839, p. 1.
1843. *Jaculus labradorius* Wagner, Suppl. Schreber's Säugthiere, III, p. 294.
1856. *Meriones acadicus* Dawson, Edinburgh New Philos. Journ., new ser., III, p. 2.
1857. *Jaculus hudsonius* Baird, Mamm. N. Am., p. 430 (in part).
1875. *Zapus hudsonius* Coues, Bull. U. S. Geol. Surv. Terr., 2d Ser., No. 5, p. 253; Mon. N. Am. Rodentia, p. 467, 1877 (in part), and recent authors (in part).
1899. *Zapus hudsonius canadensis* Batchelder, Proc. New Eng. Zool. Club, I, p. 4.
1899. *Zapus hudsonius hardyi* Batchelder, Proc. New Eng. Zool. Club, I, p. 5. (Mount Desert Island, Maine.)

Type locality.—Hudson Bay.

Geographic distribution.—As restricted in the present paper, this species is found from the southern shores of Hudson Bay south to New Jersey, and in the mountains to North Carolina, west to Iowa and Missouri, and northwest to Alaska. It intergrades with *Z. americanus* in the upper part of the Carolinian zone in the Eastern States; with *campestris* along the edge of the Great Plains, and probably with *alascensis* somewhere in northern British America.

General characters.—Size medium, smaller than *Z. insignis*, *Z. trinotatus*, or *Z. princeps*. Skull less massive, with small molars and incisive foramina.

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[1] "Inhabits Hudson's Bay and Labradore. This species was sent over from Hudson's Bay by Mr. Graham."—Kerr.

Color.—Summer pelage: Fur of entire upper parts plumbeous at base, with tips of hairs ranging from yellowish fawn to rather dark ochraceous, rather thickly flecked with black-tipped hairs; broad dorsal stripe reaching from upper part of face to base of tail much darker than remainder of upper parts, the black-tipped hairs predominating; tail rather sharply bicolor, grayish brown above and whitish beneath; lower parts white, sometimes suffused with color of sides; feet white. *Fall pelage:* Ochraceous of sides duller and more yellowish, encroaching more on the dark dorsal area, which is sometimes almost obliterated. *Young* of the year with more ochraceous in fall pelage than the adults, and a greater tendency to fulvous wash on lower parts.

Cranial characters.—Skull rather lightly built, with rather narrow brain case, small incisive foramina, and small molars; zygomata not widely spreading; rostrum not appreciably deflected.

Measurements.—Two specimens from James Bay, Canada, measured from alcohol, average: Total length, 209; tail vertebræ, 124; hind foot, 30.5. Eleven from Tower, Minn., average: Total length, 218; tail vertebræ, 133; hind foot, 30.2. Thirty-four adults from Keene Valley, Essex County, N. Y., average:[1] Total length, 216.6; tail vertebræ, 129.25; hind foot, 31.25. *Skull:* An adult skull from James Bay measures: Basilar length, 18.5; zygomatic breadth, 11; mastoid breadth, 10; interorbital constriction, 4.2; incisor to postpalatal notch, 8.5; foramen magnum to postpalatal notch, 8; fronto-palatal depth at middle of molar series, 6.5. An adult ♀ from Ossipee, N. H., measures: Basilar length, 18.8; zygomatic breadth, 11.6; mastoid breadth, 10; interorbital constriction, 4.3; incisor to postpalatal notch, 8.6; foramen magnum to postpalatal notch, 8.2; fronto-palatal depth at middle of molar series, 6.2.

General remarks.—Zapus hudsonius, the type of the genus, was until recently the only well established species. The foregoing list of synonyms indicates that it attracted the attention of many naturalists during the early part of the century, all the names published previous to 1856 referring almost exclusively to it. *Jaculus hudsonius* of Baird (= *Zapus hudsonius* Coues) is a composite species including nearly a dozen forms now recognized as distinct. The distribution of *hudsonius,* including its four well-marked subspecies, is by far the most extensive in the genus, few North American rodents equaling it in this respect.

The only specimens of *Zapus* from Hudson Bay at present available are four alcoholic examples, in rather poor condition, from James Bay, and a part of a skin from Fort Churchill, Northwest Territory. This skin has evidently been in alcohol, and hence its color can not be depended upon. I have removed several skulls from the James Bay specimens, including one perfect adult. Since this skull agrees essentially with skulls from Tower, Minn., from which place the Biological Survey has a large series, these specimens have been assumed to be fairly typical and have been used for comparison in most instances. It is quite possible, however, that a series of skins from Hudson Bay would measure slightly more than the Minnesota specimens, and would perhaps differ in color. While this material, taken in connection with what is available from the type locality is sufficient for comparison with the subspecies here recognized, it will not permit the recognition of other nominal forms which may eventually prove to be well founded. A skull from Saint Catharines, Ontario, however, which may be considered a topotype of *canadensis*, is identical in appearance with one from James Bay.

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[1] Fide Batchelder.

Specimens examined.—Total number, 319, from the following localities:

Northwest Territory: James Bay, 4; Fort Churchill, 1; Fort Rae, 1; Fort Resolution, 1.
Ontario: Nepigon, 7; North Bay, 6; Mount Forest, 3; Michipicoten, 1; Saint Catharines, 6.
New Brunswick: Oak Bay, 30.
Nova Scotia: Halifax, 6; James River, 2; Digby, 4.
Maine: Walker Pond, 4; Mount Desert Island, 4.
New Hampshire: Ossipee, 1; Fabyans, 1.
Vermont: Brandon, 1; Mount Mansfield, 1; St. Johnsbury, 2.
Massachusetts: Wareham, 70; North Truro, 6; Middleboro, 2; Wilmington, 3; Lunenburg, 2; Belmont, 2; Ipswich, 1; Concord, 4; Lexington, 1; Dighton, 1; Wellesley, 1; Barnstable Neck, 5.
Connecticut: East Hartford, 1 (not typical); Wethersfield, 2 (not typical).
New York: Peterboro, 39; Catskills, 8; Elizabethtown, 2; Waterville, 1; Patten Mills, 1; Locust Grove, 7; Lake George, 5.
New Jersey: Lake Hopatcong, 5.
Pennsylvania: Leasuresville, 3.
Maryland: Cumberland, 1; Finzel, Garrett County (6 miles north of Frostburg), 1.
West Virginia: Wheeling, 1.
North Carolina: Roan Mountain, 1; Magnetic City, 1.
Ohio: Portland Station, 1.
Indiana: Terre Haute, 1.
Wisconsin: Racine, 1.
Michigan: Seney, 1.
Minnesota: Lac qui Parle, 1; Elk River, 25; Tower, 26.

ZAPUS HUDSONIUS LADAS Bangs. Labrador Jumping Mouse.

Zapus hudsonius ladas Bangs, Proc. New Eng. Zool. Club, I, p. 10, Feb. 28, 1899.

Type locality.—Rigoulette, Hamilton Inlet, Labrador.

Geographic distribution.—Eastern Quebec north to Hamilton Inlet, Labrador; limits of range unknown.

General characters.—Larger than typical *Zapus hudsonius* with longer tail and hind foot; coloration darker; differing also in cranial characters.

Color.—*Summer pelage:* Sides rather dark, bright ochraceous buff, moderately lined with blackish-tipped hairs; dorsal area usually less distinct than in typical *hudsonius*, much flecked with ochraceous. Lower parts white, usually more or less suffused with color of sides.

Tail quite sharply bicolored, dusky above and whitish beneath; ears usually edged with ochraceous (whitish in *hudsonius*). Feet white. *Fall pelage:* Dorsal area usually even less distinct than in summer, with the general tinge of entire upper parts yellowish instead of ochraceous.

Cranial characters.—Skull longer than that of typical *hudsonius;* zygomata considerably longer; zygomatic breadth about the same as in largest skulls of *hudsonius;* interorbital constriction slightly wider; brain case higher and averaging slightly longer; rostrum and nasals longer; bullæ considerably larger; molar series averaging slightly longer.

Measurements.—Type No. 4169 ♀ ad., collection of E. A. and O. Bangs: Total length, 238; tail vertebræ, 153; hind foot, 32. Average of five adults from Black Bay, Labrador: Total length, 228; tail vertebræ, 142; hind foot, 32. *Skull:* Average of four adults from Black Bay, Labrador: Basilar length, 18.8; zygomatic breadth, 11.4; mastoid breadth, 10.2; interorbital constriction, 4.5; incisor to postpalatal notch, 8.9; foramen magnum to postpalatal notch, 8.5; fronto-palatal depth at middle of molar series, 6.3.

General remarks.—*Zapus h. ladas* is a fairly well-marked subspecies represented by 23 specimens in the collection of E. A. and O. Bangs, and 5 in the Biological Survey collection. The best characters separating this form from typical *hudsonius*, as here restricted, are the longer tail, larger hind foot, and longer skull, with larger audital bullæ. This latter character is very evident, even in young skulls.

Specimens examined.—Total number, 28, from the following localities:

Labrador: Hamilton Inlet (type locality), 3; Black Bay, 20.
Quebec: Godbout, 5.

ZAPUS HUDSONIUS ALASCENSIS Merriam. Alaska Jumping Mouse.

Zapus hudsonius alascensis Merriam, Proc. Biol. Soc. Wash., XI, p. 223, 1897.

Type locality.—Yakutat, Alaska.

Geographic distribution.—Yakutat Bay, north to Yukon River; limits of range unknown.

General characters.—Similar to *Zapus hudsonius*, but slightly larger and darker.

Color.—Sides dull, dark ochraceous, with many black-tipped hairs; dorsal area quite distinct, but thickly flecked with brownish; beneath pure white; tail rather sharply bicolor.

Cranial characters.—Skull similar to that of typical *hudsonius*, but slightly longer and narrower; zygomata less bowed outward and slightly longer; brain case narrower; molar series longer; crown of last lower molar longer.

Measurements.—Average of four specimens from type locality: Total length, 218; tail vertebræ, 132; hind foot, 31.5. *Skull:* Average of two adults from type locality: Basilar length, 18.2; zygomatic breadth, 10.7; mastoid breadth, 10.2; interorbital constriction, 4.2; incisor to postpalatal notch, 8.5; foramen magnum to postpalatal notch, 8; fronto-palatal depth at middle of molar series, 6.2.

General remarks.—*Zapus h. alascensis* is a fairly well-marked subspecies based on four specimens collected at Yakutat Bay, Alaska. Four additional specimens in the National Museum from Alaska have been examined, but are in such poor condition as to furnish no additional characters. This form undoubtedly intergrades with true *hudsonius* somewhere in northern British America.

Specimens examined.—Total number, 8, from the following localities:

Alaska: Nushagak, 2; Yakutat Bay, 4; Yukon River, 2.

ZAPUS HUDSONIUS AMERICANUS (Barton). Carolinian Jumping Mouse.

Dipus americanus Barton, Trans. Am. Philos. Soc., IV, No. XII, p. 115, 1799.
Zapus hudsonius americanus Batchelder, Proc. New Eng. Zool. Club, I, p. 6, 1899.

Type locality.—Philadelphia, Pa.

Geographic distribution.—From vicinity of Raleigh, N. C., north through Upper Austral zone along coastal plain to southern Connecticut and lower Hudson Valley, intergrading in upper edge of its range with *Z. hudsonius.*

General characters.—Similar to *Zapus hudsonius*, but smaller; dorsal area less distinct; skull and teeth smaller.

Color.—Description of specimens in summer pelage from Raleigh, N. C.: Entire upper parts deep dull ochraceous, the dorsal area very indistinct and but slightly mixed with black-tipped hairs; sides of head much lighter than remainder of upper parts; ears very dark, nearly black; under parts whitish, suffused with ochraceous. In the fall the dorsal area is indistinct and very thickly flecked with yellowish-tipped hairs; sides dull yellowish.

Cranial characters.—Skull considerably smaller than in *Z. hudsonius*, with zygomata more arched and brain case shorter; incisive foramina shorter and relatively broader; interorbital breadth about the same; rostrum relatively deeper and shorter; molar series shorter.

Measurements.—Average of 7 adults from Raleigh, N. C.: Total length, 191.3; tail vertebræ, 115.4; hind foot, 28.3.[1] Two from Washington, D. C., average: Total length, 198.5; tail vertebræ, 117.5; hind foot, 28. *Skull*: Average of two from Raleigh, N. C.: Basilar length, 17; zygomatic breadth, 10.3; mastoid breadth, 9.2; interorbital constriction, 3.9; incisor to postpalatal notch, 8.2; foramen magnum to postpalatal notch, 7.5; fronto-palatal depth at middle of molar series, 6.

General remarks.—It is unfortunate that the name *americanus* must be adopted for this subspecies, since it was based on specimens clearly intermediate between the extremes of this form and true *hudsonius.*

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[1] Fide Batchelder.

Specimens examined.—Total number, 54, from the following localities:

New York: Long Island, 3; Montauk Point, 8; Raynor Beach, 1; Roslyn, 3; Sing Sing (not typical), 1.
New Jersey: Chatham, 1; Englewood, 1; Mount Holly, 2; 'New Jersey', 1; Phillipsburg, 1.
Pennsylvania: Chester County, 1; Culver Lake, 2; Delaware County, 2; Marple (Delaware County), 1; Schuylkill, 1; Tinicum (Delaware County), 1; Upper Darby, 1.
Maryland: Kensington, 1; Laurel, 4; Prince George County, 5; Sandy Spring, 1.
District of Columbia: Washington, 2.
Virginia: Accotink, 1; Falls Church, 1.
North Carolina: Raleigh, 7; Weaverville, 1.

ZAPUS HUDSONIUS CAMPESTRIS subsp. nov. Prairie Jumping Mouse.

Type from Bear Lodge Mountains, Wyoming, No. 65872, ♂ ad., U. S. Nat. Museum, Biological Survey Coll. Collected June 12, 1894, by B. H. Dutcher. Original No. 600.

Geographic distribution.—Great Plains from Manitoba southward to Nebraska and westward to Colorado and Wyoming.

General characters.—Similar to *Z. hudsonius*, but slightly larger and brighter in color; differing also in cranial characters.

Color.—*Summer pelage:* Sides bright ochraceous-buff, similar to brightest specimens of *hudsonius* from Eastern States, moderately lined with black-tipped hairs; dorsal area distinct, strongly suffused with color of sides; tail yellowish white below, dark grayish above. *Fall pelage:* Sides dull yellowish instead of ochraceous; dorsal area nearly black, very slightly flecked with yellowish-tipped hairs; dorsal surface of tail much darker than in summer; ears darker, conspicuously bordered with whitish.

Cranial characters.—Skull slightly larger than in *Z. hudsonius.* Skulls from the type locality, compared with those of *Z. hudsonius* from Tower, Minn., agree in interorbital breadth; brain case about as wide but higher; incisive foramina slightly larger; process on lower border of maxillary portion of zygoma more pronounced; viewed in profile, the cranium is more evenly curved.

Measurements.—Average of 4 adults from type locality: Total length, 222; tail vertebræ, 135; hind foot, 30.5. *Skull:* Average of 4 adult skulls from type locality: Basilar length, 18.7; zygomatic breadth, 11.4; mastoid breadth, 10.4; interorbital constriction, 4.2; incisor to postpalatal notch, 8.9; foramen magnum to postpalatal notch, 7.9; frontopalatal depth at middle of molar series, 6.3.

General remarks.—The present well-marked form replaces *Z. hudsonius* over the northern and more elevated portions of the plains west of Minnesota and Iowa to the base of the Rocky Mountains. The characters of this form remain remarkably constant throughout its known range. While no good intergrades have been examined, it doubtless does intergrade with true *hudsonius* in western Minnesota. The difference between summer and early fall pelage is very great, apparently greater than in any other species.

Specimens examined.—Total number, 35, from the following localities:

Manitoba: Carberry, 2; Portage la Prairie, 1; Red River settlement, 4; Selkirk settlement, 1.
North Dakota: Devils Lake, 1; Fort Sisseton, 1; Fort Wadsworth, 1; Pembina, 2.
Montana: Little Big Horn River, 1.
South Dakota: Custer, 4.
Wyoming: Bear Lodge Mountains (type locality), 6; Cheyenne, 1; Devils Tower, 1; Sherman, 1; Sundance, 1
Nebraska: Columbus, 1.
Colorado: Loveland, 5.
Missouri: Jackson County, 1.

ZAPUS TENELLUS Merriam. Kamloops Jumping Mouse.

Zapus tenellus Merriam, Proc. Biol. Soc. Wash., XI, p. 103, April 26, 1897.

Type locality.—Kamloops, British Columbia.

Geographic distribution.—Known only from vicinity of type locality.

General characters.—Size rather small; ears rather large; coloration dark.

Color.—*Early fall pelage:* Somewhat similar to *Zapus hudsonius* in corresponding pelage but much darker; sides olive yellowish, heavily intermixed with black-tipped hairs; dorsal area somewhat as in *hudsonius*, but not well defined, contrasting less with sides; tail sharply bicolor, darker above and at tip than in *hudsonius;* nose, ears, and outer sides of thigh and forearm dusky, much darker than in *hudsonius;* fore and hind feet soiled whitish.

Cranial characters.—Skull similar to that of *Zapus hudsonius*, but less swollen in frontal region; border of ascending portion of jugal straighter; cranium more arched.

Measurements.—Average of four specimens from type locality: Total length, 208; tail vertebræ, 128; hind foot, 30.5. *Skull:* Average of 3 skulls from type locality: Basilar length, 16.5; zygomatic breadth, 10.6; mastoid breadth, 9.6; interorbital constriction, 4.2; incisor to postpalatal notch, 7.6; foramen magnum to postpalatal notch, 6.9; frontopalatal depth at middle of molar series, 5.7.

General remarks.—*Zapus tenellus* is a well-marked form requiring comparison only with *Z. hudsonius* and its subspecies *alascensis.* In color it resembles *alascensis*, but in cranial characters it departs from *hudsonius* in another direction. There is a possibility that it may be found to intergrade with one of them to the northward, but until such intergradation is proved, it seems best to allow it full specific rank.

Specimens examined.—Total number, 7, from the following localities:

British Columbia: Ducks, 2; Kamloops, 5.

ZAPUS PRINCEPS Allen. Rocky Mountain Jumping Mouse.

(Pl. I, figs. 6, 6*a*.)

Zapus princeps J. A. Allen, Bull. Am. Mus. Nat. Hist., N. Y., V, p. 71, April 28, 1893.

Type locality.—Florida, La Plata County, Colo.

Geographic distribution.—Rocky Mountain region from northern New Mexico northward to Henry House, Alberta.

General characters.—Size large; skull broad and heavy, much as in *Z. hudsonius*, but much larger.

Color.—*Summer pelage:* "Above with the middle of the dorsal region pale yellowish brown, profusely mixed with blackish, so that sometimes the blackish color, sometimes the pale yellowish brown, predominates; sides of the body, forming a band on either side about equal to the dark dorsal area, yellowish brown, slightly mixed with blackish, except over a narrow lateral line, adjoining the white of lower parts, which is a clear, strong yellowish brown; lower parts white to the base of the hairs, varying in some specimens to strong ochraceous; tail indistinctly bicolor—grayish white below and pale brown above, and very thinly haired; hind feet grayish white above like the lower surface of the tail; ears narrowly edged with yellowish white."[1] In *fall pelage* adults have the dorsal area with more black and sides more yellowish than in summer; under parts pure white; immature in same pelage similar, but with dorsal area more suffused with yellowish; under parts some what suffused with color of sides.

Cranial characters.—Skull large and heavy, with rather heavy dentition. In some specimens the premolar is very small, occasionally being flattened against the adjacent tooth and scarcely functional. Immature skull short and broad, with large brain case. The incisive foramina in this and closely related species much larger than in those more nearly related to *Z. hudsonius*.

Measurements.—Average of 7 specimens from Fort Garland, Colo.: Total length, 245; tail vertebræ, 147; hind foot, 32. Average of 4 from La Barge Creek, Wyo.: Total length, 239; tail vertebræ, 150; hind foot, 32. Average of 6 from St. Mary Lake, Mont.: Total length, 232; tail vertebræ, 139; hind foot, 32. *Skull:* Average of 2 adult skulls from Fort Garland, Colo.: Basilar length, 20.7; zygomatic breadth, 12.5; mastoid breadth, 11; interorbital constriction, 4 5; incisor to postpalatal notch, 9.8; foramen magnum to postpalatal notch, 8.8; fronto-palatal depth at middle of molar series, 6.6. One from Preuss Mountains, Idaho: Basilar length, 20.5; zygomatic breadth, 13.2; mastoid breadth, 11; interorbital constriction, 4.8; incisor to postpalatal notch, 9.8; foramen magnum to postpalatal notch, 8.8; fronto-palatal depth at middle of molar series, 6.5.

General remarks.—*Zapus princeps* is one of the largest species of the genus and has the widest range of any except *Z. hudsonius*. It is mostly confined to mountains, though northward its range extends over the plains of Assiniboia and Saskatchewan, where it grades into the form here described as subspecies *minor*.

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[1] From original description in Bull. Am. Mus. Nat. Hist., N. Y., V, p. 71, 1893.

Specimens examined.—Total number, 101, from the following localities:

Alberta: Crow Nest Pass (Rocky Mountains near forty-ninth parallel), 1; Henry House, 2; 15 miles south of Henry House, 3.
British Columbia: Field, 3; Glacier, 1.
Montana: Bear Paw Mountains, 6; Big Snowy Mountains, 12; Blackfoot Agency, 2; Fort Ellis, 1; Paola, 1; Pryor Mountains, 1; St. Marys Lake, 13; Summit, 5; Upper Stillwater Lake, 2.
Idaho: Preuss Mountains, 8; Salmon River Mountains, 5.
Wyoming: Clark Fork, 1; La Barge Creek, 11; Yellowstone Lake, 1.
Colorado: Cochetope Pass, 1; Florida (type locality), 5; Fort Garland, 10; Gold Hill, 2; Rocky Mountains (39°), 1.
New Mexico: Camp Burgwyn, 2; Santa Fe, 1.

ZAPUS PRINCEPS MINOR subsp. nov. Saskatchewan Jumping Mouse.

Type from Wingard, near Carlton House, Saskatchewan, No. 73673, ♀ ad., U. S. Nat. Museum, Biological Survey Coll. Collected July 23, 1895, by J. Alden Loring. Original No. 3123.

Geographic distribution.—Plains of Saskatchewan; limits of range unknown.

General characters.—Similar to *Zapus princeps*, but smaller and differing in color and cranial characters.

Color.—*Summer pelage:* Similar to *Z. princeps*, but dorsal area darker; lower parts suffused with salmon. *Fall pelage* with dorsal area thickly flecked with yellowish and sides yellowish olive; lower parts much as in summer.

Cranial characters.—Skulls of the present form from Osler and Wingard, Saskatchewan, compared with those of *Z. princeps* from Colorado, differ as follows: Smaller; rostrum shorter and more deflected; nasals much narrower anteriorly; brain case relatively higher; interpterygoid fossa shallower.

Measurements.—Average of 10 specimens from Osler, Saskatchewan: Total length, 219; tail vertebræ, 131; hind foot, 29.9. Average of 2 from type locality: Total length, 220; tail vertebræ, 131.5; hind foot, 28. *Skull*: Average of 3 skulls from Osler, Saskatchewan: Basilar length, 18.7; zygomatic breadth, 12.2; mastoid breadth, 10.7; interorbital constriction, 4.4; incisor to postpalatal notch, 9; foramen magnum to postpalatal notch, 8.3; fronto-palatal depth at middle of molar series, 6.7.

General remarks.—*Z. minor* is a well-marked subspecies requiring comparison only with *Z. princeps*. It is evidently the northern plains representative of that species, probably intergrading with it in Assiniboia and eastern Alberta near the United States boundary and along the eastern base of the Canadian Rockies. Lack of specimens from this region makes it impossible to conclusively settle this point.

Specimens examined.—Total number, 21, from the following localities:

Saskatchewan: Osler, 15; Wingard (type locality), 3.
Assiniboia: Indian Head, 3.

ZAPUS PRINCEPS OREGONUS subsp. nov. Blue Mountains Jumping Mouse.

Type from Elgin, Blue Mountains, Oregon, No. 78156, ♂ ad., U. S. Nat. Museum, Biological Survey Coll. Collected May 29, 1896, by Edward A. Preble. Original No. 959.

Geographic distribution.—Blue Mountains of Oregon.

General characters.—Similar to *Zapus princeps*, but differing in color and in cranial characters.

Color.—*Early summer pelage:* Very similar to *Z. princeps*, but slightly lighter on sides, especially anteriorly; dorsal area and head more finely flecked with color of sides, the head especially presenting a grayish appearance; beneath pure white; whitish edging of ears very indistinct.

Cranial characters.—Compared with *Z. princeps* from Colorado, the skull of the present form differs as follows: Brain case more rounded, especially shorter and more rounded behind; zygomata shorter; incisive foramina larger and very much broader behind; audital bullæ slightly smaller.

Measurements.—Type: Total length, 250; tail vertebræ, 154; hind foot, 33. Average of 3 adults from Strawberry Butte, Oregon: Total length, 243; tail vertebræ, 146; hind foot, 32. *Skull:* Average of 3 adult skulls from type locality: Basilar length, 20.1; zygomatic breadth, 12.9; mastoid breadth, 11; interorbital constriction, 4.4; incisor to postpalatal notch, 9.7; foramen magnum to postpalatal notch, 8.5; frontopalatal depth at middle of molar series, 6.5.

General remarks.—The present form seems to replace *Z. princeps* throughout the Blue Mountains region of northeastern Oregon. Specimens from this region agree very constantly with each other and differ from typical *Z. princeps* as above indicated. It is much larger than and not at all closely related to *Z. montanus*, its relative on the west. A specimen from Mountain City, Nev., in the Brunneau Mountains, though differing in many details, is doubtfully referred to this form. Externally it differs considerably from *Z. oregonus* and agrees with *Z. nevadensis*, from the Ruby Mountains, Nev., though the skull shows that it is not closely related to that form. The skull of the Mountain City specimen also differs somewhat from that of typical *Z. oregonus*, and additional material will doubtless show it to represent a form which merits separation.

Specimens examined.—Total number, 9, from the following localities:

Oregon: Elgin, 3; Harney (10 miles north), 2; Strawberry Butte, 3.
Nevada: Mountain City (not typical), 1.

ZAPUS MAJOR sp. nov. Warner Mountain Jumping Mouse.

Type from Warner Mountains, Oregon, No. 79983, ♀ ad., U. S. Nat. Museum, Biological Survey Coll. Collected August 4, 1896, by C. Hart Merriam and Vernon Bailey. Original No. 5720.

Geographic distribution.—Known only from the type locality.

General characters.—Similar externally to *Zapus princeps*, but larger; skull closely resembling that of *Z. trinotatus*.

Color.—Type in summer pelage: Sides ochraceous-buff, moderately lined with black-tipped hairs; back slightly darker, thickly flecked with black; tail not sharply bicolored; beneath, dull white; feet soiled white.

Cranial characters.—Skull massive; brain case high and broad; zygomata rather short; palate broad and long; interpterygoid fossa broad and shallow, with bordering edge of palate much excavated. Maxillary portion of zygomata heavy and nearly perpendicular to main axis of skull; incisive foramina large and elliptical. The skull of *Z. major* differs from those of *Z. trinotatus* taken near type locality and from northern Washington, as follows: Rostrum larger and nasals broader; brain case higher; ascending portion of jugal steeper.

Measurements.—Type: Total length, 255; tail vertebræ, 155; hind foot, 35. *Skull* (type): Basilar length, 20.4; zygomatic breadth, 13; mastoid breadth, 11.2; interorbital constriction, 4.7; incisor to postpalatal notch, 10; foramen magnum to postpalatal notch, 8.6; frontopalatal depth at middle of molar series, 6.5.

General remarks.—The present form is based on a single adult specimen from the Warner Mountains, in southern Oregon. The skull bears some resemblance, especially in the form of the brain case, to those of *Z. trinotatus* and its subspecies *alleni.* It is apparently shut off by natural barriers from all of the forms surrounding it, with the possible exception of *Z. montanus*, and has no close affinities with them. From *Z. montanus* it differs to such an extent that intergradation is out of the question.

Specimens examined.—The type.

ZAPUS NEVADENSIS sp. nov. Nevada Jumping Mouse.

Type from Ruby Mountains, Nevada, No. 94185, ♀ ad., U. S. Nat. Museum, Biological Survey Coll. Collected June 21, 1898, by Vernon Bailey. Original No. 6581.

Geographic distribution.—Known only from type locality.

General characters.—Size rather large; color light; molar series long and rather narrow.

Color.—Dorsal area about as in *Z. princeps*, pale yellowish-brown, profusely mixed with black-tipped hairs; sides light ochraceous-buff, becoming almost white on cheeks, moderately lined with black-tipped hairs, the basal portion of fur cinereous, noticeably lighter in color than in *Z. princeps*, with a few white hairs intermixed; beneath, pure white.

Cranial characters.—The skull of the type and only known specimen is large, but rather lightly built. Compared with skulls of *Z. princeps* from Colorado it is smaller and flatter; brain case shorter and more rounded; incisive foramina small and elliptical; bullæ smaller; molars rather narrow, but molar series long; zygomata short and not broadly spreading. Compared with skulls of *Z. trinotatus alleni* from the Sierra Nevada, Calif., it differs as follows: Smaller, but with molar series longer; incisive foramina smaller and narrower posteriorly; zygomata shorter and less spreading; brain case flatter; rostrum shorter. Compared with the skull of the specimen from Mountain City, Nev., doubtfully referred to *Z. oregonus*, the type differs as follows: Slightly smaller and younger; zygomata shorter and zygomatic breadth slightly less; shape of brain case not strikingly different; molar series decidedly longer; incisive foramina very much smaller and narrower posteriorly; postpalatal notch indenting palate farther, nearly to middle of posterior molars; bullæ slightly smaller. Mandible slighter, but lower molar series longer.

Measurements.—Type: Total length, 242; tail vertebræ, 150; hind foot, 33. *Skull* (type): Basilar length, 19.4; zygomatic breadth, 12; mastoid breadth, 11; interorbital constriction, 4.6; incisor to postpalatal notch, 9.5; foramen magnum to postpalatal notch, 8; fronto-palatal depth at middle of molar series, 6.

General remarks.—The present form is based on a single adult specimen collected in the Ruby Mountains in east-central Nevada. It does not seem to be closely related to any of the forms whose ranges partially surround its habitat. While it is probably most nearly related to *Z. princeps*, it seems to differ enough to warrant specific separation.

Specimens examined.—The type.

ZAPUS TRINOTATUS Rhoads. Northwest Jumping Mouse.

(Pl. I, figs. 5, 5a.)

Zapus trinotatus Rhoads, Proc. Acad. Nat. Sci. Phila., 1894, p. 421, Jan. 15, 1895.

Zapus imperator Elliot, Field Columbian Mus., Pub. 30, Zool. Ser., I, No. 11, p. 228, Feb. 1, 1899; ibid, No. 13, pp. 260-261, 1 fig. in text, March, 1899. (Type from Sieg's ranch, Elwah River, Clallam County, Wash.)

Type locality.—Lulu Island, mouth of Fraser River, British Columbia.

Geographic distribution.—Coast region of southern British Columbia, Washington (including Cascades), Oregon (west of western base of Cascades), and northern California, south to Humboldt Bay.

General characters.—Size large; color bright; skull large and broad.

Color.—*Summer pelage:* Sides dark ochraceous-buff, rather heavily lined with black-tipped hairs; dorsal area very distinct, moderately flecked with color of sides; beneath white, frequently suffused or blotched with fulvous, especially in young; outer surface of forearm and legs dusky; tail quite strongly bicolored, in dried skins dusky brown above and yellowish-white below. In *early fall pelage* the sides are dull yellowish instead of ochraceous; dorsal area duller than in summer, much more thickly flecked with yellowish hairs. In immature individuals the dorsal area is especially indistinct.

Cranial characters.—Skull large and rather heavily built, about the size of that of *Z. princeps*. Brain case broader and more globular; zygomatic breadth greater; palate shorter; molars more lightly built than in that species.

Measurements.—Average of 4 adults from Neah Bay, Wash.: Total length, 248; tail vertebræ, 153; hind foot, 33.5. Four specimens from Lake Washington, Wash., average: Total length, 240; tail vertebræ, 147.5; hind foot, 34.2. Ten specimens from Lake Cushman, Wash., average: Total length, 239.5; tail vertebræ, 144.5; hind foot, 32.5. *Skull:* Six adult skulls from five localities in Washington, average: Basilar length, 20.2; zygomatic breadth, 13; mastoid breadth, 10.9; interorbital constriction, 4.3; incisor to postpalatal notch, 9.6; foramen magnum to postpalatal notch, 8.8; fronto-palatal depth at middle of molar series, 6.7.

General remarks.—*Zapus trinotatus* is one of the largest, and in early summer pelage one of the most showy species in the genus. In the absence of specimens from the exact type locality, specimens from Port Moody, British Columbia, a few miles distant on the mainland, are assumed to be typical.[1] The species is remarkably constant in characters throughout its range, examples from near the type locality not differing much from specimens from Yaquina Bay, Oregon. In the Sierra Nevada of California this species is replaced by the closely related subspecies *alleni.* In a recent paper entitled 'Preliminary descriptions of New Rodents from the Olympic Mountains,' Mr. D. G. Elliot has described the *Zapus* from that region under the name *Zapus imperator*, but in making his comparisons he ignores *Z. trinotatus*, contrasting *imperator* only with *Z. princeps.* Through the courtesy of the author I have been able to examine the type and a topotype of *imperator.* They do not differ sufficiently from *Z. trinotatus*, from the contiguous coast region and from the type locality, to admit of even subspecific separation.

Specimens examined.—Total number, 99, from the following localities:

British Columbia: Lulu Island (type locality), 2; Mount Baker Range, 4; Mount Lehman, 1; Port Moody, 3; Sumas, 3.

California: Crescent City, 1; Mad River (Carson's Camp), 1.

Oregon: Astoria, 1; Beaverton, 3; Elk Head, 1; Glendale, 1; Lincoln County, 1; Marshfield, 1; Salem, 1; Yaquina Bay, 9.

Washington: Cascade River (head), 2; Easton, 3; Granville, 1; Fort Steilacoom, 1; Kichelos Lake, 1; Lake Cushman, 15; Lake Washington, 4; Lapush, 2; Mount Rainier, 12; Mount St. Helens, 3; Neah Bay, 5; Nisqually River, 4; Olympic Mountains (head Elwah River), 2[2]; Olympic Mountains (head Soleduc River), 2; Pacific County, 5; Puget Sound, 3; 'Washington,' 1.

ZAPUS TRINOTATUS ALLENI Elliot. Allen's Jumping Mouse.

Zapus alleni Elliot, Field Columbian Mus., Pub. 27, Zool. Ser., I, No. 10, pp. 212–213, March, 1898.

Type locality.—Pyramid Peak, Lake Tahoe, California.

Geographic distribution.—Mount Shasta and southward in the Sierra Nevada to Mammoth and North Fork of Kern River, California.

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[1] Since the above was written the type and a topotype have been examined and found to agree with the specimens from Port Moody.

[2] Type and topotype of *Zapus imperator*.

General characters.—Similar to *Z. trinotatus;* differing slightly in external and cranial characters.

Color.—Early summer pelage: Sides rather pale ochraceous-buff, only moderately lined with black-tipped hairs; dark dorsal area well defined, rather lighter than in *Z. trinotatus;* under parts pure white; never marked with fulvous, except that rarely young specimens are slightly suffused with this color beneath; tail in dried skins rather light grayish-brown above and yellowish-white below; tail lighter toward tip, the pencil often white. Compared with *Z. trinotatus*, adults of this species have dorsal area less flecked with color of sides and fewer black-tipped hairs on sides. Upper surface of tail, ears, head, and outer surface of thighs lighter than in *Z. trinotatus.* Immature individuals in late summer pelage have dorsal area very indistinct and much mixed with ochraceous. *Fall pelage:* An adult taken at Cassel, Calif., August 29 (very fat and doubtless about to hibernate), is in a pelage quite similar to that worn in early summer, but the sides are lighter ochraceous, especially anteriorly, and the dorsal area is more thickly flecked with color of sides. *Z. alleni* apparently does not assume the dull yellowish fall pelage of *Z. trinotatus.*

Cranial characters.—Skulls similar to those of *Z. trinotatus*, but smaller, with much smaller bullæ. From that of *Z. montanus* of the Cascade Range the skull of the present species differs so much as not to require comparison.

Measurements.—Eight adults from Emerald Bay, Lake Tahoe, average: Total length, 234.6; tail vertebræ, 143.6; hind foot, 32.5. Two adults from Mount Shasta, Calif., average: Total length, 249.5; tail vertebræ, 152.5; hind foot, 32.5. *Skull:* Eight skulls from Emerald Bay, Lake Tahoe, average: Basilar length, 19.7; zygomatic breadth, 12.6; mastoid breadth, 10.5; interorbital constriction, 4.5; incisor to postpalatal notch, 9.3; foramen magnum to postpalatal notch, 8.2; fronto-palatal depth at middle of molar series, 6.5.

General remarks.—*Zapus t. alleni* is a fairly well-marked subspecies occupying the Sierra Nevada of California, from Mount Shasta south to the region about the head of the North Fork of Kern River. It is a very beautiful species and differs from all others of this subgenus in often having the pencil, and occasionally more of the tail, white.

Specimens examined.—Total number, 61, from the following localities:

California: Big Trees, 1; Cassel, 1; East Fork Kaweah River, 2; Emerald Bay, Lake Tahoe, 19; Kern River (North Fork—'Kern Lakes'), 1; Lassen Peak, 14; Mammoth, 1; Mount Shasta, 20; Summit, 1; Upper Bear Creek, 1.

ZAPUS MONTANUS (Merriam). Mountain Jumping Mouse.

Zapus trinotatus montanus Merriam, Proc. Biol. Soc. Wash., XI, p. 104, April 26, 1897.

Type locality.—Crater Lake, Mount Mazama, Oregon.

Geographic distribution.—Cascade Range in Oregon.

General characters.—Smaller and duller in color than *Z. trinotatus;* also differing in cranial characters.

Color.—Summer pelage: Sides rather dark, ochraceous-buff, heavily lined with black-tipped hairs; dorsal area quite sharply defined, grizzled dusky and yellowish; outer side of legs dusky to heel; tail sharply bicolor, dark gray above and whitish beneath; fore and hind feet soiled white; immature, suffused beneath with yellowish. *Fall pelage:* Dorsal area darker than in summer, thickly flecked with light yellowish, presenting a pepper-and-salt appearance; sides yellowish-olive, heavily lined with black-tipped hairs.

Cranial characters.—Skull smaller than those of *Z. trinotatus* and *Z. princeps oregonus* and much narrower throughout; incisive foramina much narrower posteriorly; bullæ smaller.

Measurements.—Eight specimens from type locality average: Total length, 228; tail vertebræ, 135; hind foot, 31. *Skull:* Three skulls from type locality average: Basilar length, 19.5; zygomatic breadth, 12.4; mastoid breadth, 10.1; interorbital constriction, 4.5; incisor to postpalatal notch, 9; foramen magnum to postpalatal notch, 8.3; fronto-palatal depth at middle of molar series, 6.4.

General remarks.—Zapus montanus is a very well-marked form inhabiting the entire Cascade Range in Oregon. It is apparently totally distinct from all of the species whose ranges surround its habitat. The type series was taken in August, 1896, near Crater Lake at the head of a tributary of Anna Creek, on Mount Mazama, Oregon. The species was quite abundant in the meadows and the shrubbery of the wet hillsides, and nearly a dozen were taken within a few days. Several of their summer nests were found. A week or two later other specimens were taken in the same valley a few miles below. These had begun to assume the fall pelage, being slightly more olivaceous.

Two specimens taken September 9, at Fort Klamath, at the base of the mountains, had assumed the complete fall pelage. They were excessively fat, and were doubtless nearly ready to hibernate.

Specimens examined.—Total number, 16, from the following localities:

Oregon: Crater Lake (type locality), 9; Diamond Lake, 1; Fort Klamath, 2; Mount Mazama (Anna Creek), 2; Mount Hood, 2.

ZAPUS ORARIUS sp. nov. Coast Jumping Mouse.

(Pl. I, figs 4, 4a).

Type from Point Reyes, Calif., No. 250, ♂ ad., collection of E. A. and O. Bangs. Collected May 14, 1893, by Charles A. Allen. Original No. 618.

Geographic distribution.—Coast of California from Point Reyes north to Mad River, Humboldt County; limits of range unknown.

General characters.—Size, medium; dorsal area and lower parts strongly suffused with color of sides. Skull rather small and peculiar in shape.

Color.—Type in rather worn spring pelage: Sides of body and head rather dark ochraceous, moderately lined with black-tipped hairs; dorsal area not sharply defined and strongly suffused with color of sides. White of lower parts so strongly suffused with ochraceous that the white is almost obsolete, appearing only on lower parts of forelegs and between thighs; hind legs ochraceous all around; sides of throat deeper ochraceous than remainder of lower parts; feet yellowish white; tail yellowish-white below and grayish above. A specimen from Point Reyes, in the collection of Dr. C. Hart Merriam, about one-fourth grown, "has the upper parts almost uniform deep ochraceous yellow, with only the faintest trace of the dorsal area."

Cranial characters.—Skull rather small; rostrum short and considerably deflected; nasals very narrow anteriorly; greatest zygomatic breadth on plane of middle molars; zygomata rather light, the maxillary portion meeting nearly at right angles to main axis of skull; process on lower border of maxillary arm of zygoma very pronounced and nearer antorbital foramen than in any other species. Brain case high and rather globular in shape; interorbital constriction narrow; interpterygoid fossa narrow and shallow; incisive foramina rather small and evenly elliptical in shape; audital bullæ small and rather near together; upper incisors slender and more projecting than usual; mandibular symphysis short.

Measurements.—The type measures: Total length, 220; tail vertebræ, 127; hind foot (dry), 30. *Skull* (type): Basilar length, 19; zygomatic breadth, 12; mastoid breadth, 10.6; interorbital constriction, 4; incisor to postpalatal notch, 8.5; foramen magnum to postpalatal notch, 7.9; fronto-palatal depth at middle of molar series, 6.2.

General remarks.—*Zapus orarius* appears to be a very well-marked species requiring close comparison with no other known form. The type has the lower parts more intensely suffused with the color of the sides than any other specimen of the genus that I have seen. A specimen from Mad River, Humboldt County, resembles the type very closely, and another from Eureka, without a skull, undoubtedly belongs to this species. The latter is suffused beneath with ochraceous, though to a lesser extent than the type. The skull of the type bears a slight resemblance in some respects to that of *Z. pacificus*, but the differences are so great that unless the type specimen is abnormal *orarius* can not be considered closely related to *pacificus*. Much additional material is needed to clear up satisfactorily the relationships of these and other forms from this region.

Specimens examined.—Total number, 4, from the following localities:

California: Eureka, 1; Mad River (Carson's Camp), 1; Point Reyes (type locality), 2.

ZAPUS PACIFICUS Merriam. Pacific Jumping Mouse.

Zapus pacificus Merriam, Proc. Biol. Soc. Wash., XI, p. 104, April 26, 1897.

Type locality.—Prospect, Rogue River Valley, Oregon.

Geographic distribution.—Interior valleys of southwestern Oregon and northwestern California; limits of range unknown.

Color.—"Dorsal area not sharply defined, but so strongly suffused with yellowish that the yellow predominates over the black; sides buffy-yellow, moderately lined with black hairs; inner side of legs only slightly darkened; tail sharply bicolor; grayish above, white beneath; fore and hind feet soiled white."[1] A topotype, younger than the type from which the above description was taken, "has the dorsal area even less distinct, the entire upper parts being ochraceous yellow."

Cranial characters.—Compared with that of *Z. montanus* (its nearest relative geographically) the skull of *Z. pacificus* is smaller; the rostrum and nasals shorter; audital bullæ smaller; basi-occipital broader between bullæ; interpterygoid fossa shorter; upper molar series more divaricating posteriorly.

Measurements.—The type measures: Total length, 225; tail vertebræ, 141; hind foot, 31. *Skull:* Basilar length, 17.5; zygomatic breadth, 12; mastoid breadth, 10; interorbital constriction, 4.5; incisor to postpalatal notch, 8.4; foramen magnum to postpalatal notch, 7.2; frontopalatal depth at middle of molar series, 6.

General remarks.—Owing to the small number of specimens available from the immediate region, it is impossible to discuss satisfactorily the true relationship of *Zapus pacificus* to the surrounding species. The type and a topotype taken at the same time are in a peculiar washed-out, almost albinistic, pelage, and may possibly be abnormal, especially as the locality is well within the humid, heavily forested area, where most of the animals are darker in color than their congeners to the eastward. The species, however, has fairly well marked skull characters and is undoubtedly a good form. An immature specimen from Siskiyou, Oreg., taken September 28, doubtless referable to this form, has dorsal area more distinct; sides brighter ochraceous and with more black hairs; upper surface of tail darker and fur of upper parts darker at base than specimens from the type locality. Another, from Little Shasta, Calif., taken September 20, also provisionally referred to this form, resembles the Siskiyou specimen, but has dorsal area finely flecked with yellowish instead of ochraceous.

Specimens examined.—Total number, 4, from the following localities:

Oregon: Prospect, Rogue River Valley (type locality), 2; Siskiyou, 1 (not typical).

California: Little Shasta, 1 (not typical).

ZAPUS SALTATOR Allen. Stickeen Jumping Mouse.

Zapus saltator Allen, Bull. Am. Mus. Nat. Hist., N. Y., XII, p. 3, Mar. 4, 1899.

Type locality.—Telegraph Creek, Northwest Territory, Canada.

Geographic distribution.—Telegraph Creek south to mouth of Skeena River and Tschimshian Peninsula; limits of range unknown.

General characters.—Similar in early fall pelage to *Z. trinotatus*, but smaller and differing in cranial characters.

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[1] From original description.

Color.—Fall pelage: Sides yellowish, moderately lined with black-tipped hairs; dorsal area well-defined, rather dark, and thickly flecked with yellowish; ears like back, narrowly edged with yellowish; beneath, pure white; tail dusky above and gray beneath. Compared with *Z. trinotatus* in corresponding pelage, the back is slightly darker, the tail darker above, and gray, instead of yellowish-white beneath.

Cranial characters.—Compared with *Z. trinotatus*, the skull of *Z. saltator* differs as follows: Brain case narrower; zygomatic breadth considerably less; nasals broader posteriorly. Compared with skulls of *Z. princeps* from Field and Glacier, British Columbia, and Henry House, Alberta, the skull of *Z. saltator* has the rostrum longer; palate from incisive foramina to postpalatal notch shorter; and molars, especially last upper, smaller. All of the skulls of *Z. saltator* examined agree very well among themselves, and all have the incisive foramina very large and broad posteriorly. The zygomatic expansion is small and the brain case high and narrow.

Measurements.—An adult from Port Simpson, British Columbia, measures: Total length, 245; tail vertebræ, 145; hind foot, 32. Average of five young adults from same locality: Total length, 234; tail vertebræ, 151; hind foot, 32. *Skull:* An adult skull from Port Simpson, British Columbia, measures: Basilar length, 20; zygomatic breadth, 11.8; mastoid breadth, 10.5; interorbital constriction, 4.5; incisor to postpalatal notch, 9.4; foramen magnum to postpalatal notch, 8; frontopalatal depth at middle of molar series, 6.4.

General remarks.—*Zapus saltator* is a well-marked form, differing considerably from its relatives to the southward. With *Z. hudsonius alascensis*, which probably meets it on the north, it requires no comparison, the immensely larger incisive foramina and larger molars of the present species distinguishing the two forms at a glance. A small series of *Z. saltator*, which forms the basis of the present description, was taken by the writer at Port Simpson, British Columbia, in August, 1897. Some of these were taken in a grassy thicket near the edge of the forest, a few feet above high-water mark, and the remainder in a garden in the village. *Z. saltator* may be found to intergrade with either *Z. trinotatus* or *Z. princeps* (it seems nearer the latter), but until its true relationship is proved it seems best to allow it full specific rank. The tail is longer and the hind foot shorter, relatively, than in *Z. trinotatus.* Through the kindness of Dr. J. A. Allen, I have been enabled to examine the type of *Z. saltator.* The skull of the type being imperfect, the cranial characters given above are taken from Port Simpson specimens.

Specimens examined.—Total number, 8, from the following localities:

Northwest Territory: Telegraph Creek, 1 (the type).
British Columbia: Inverness (mouth of Skeena River), 1; Port Simpson, 6.

NAPÆOZAPUS[1] subgenus novum.

Type Zapus insignis Miller, from Restigouche River, New Brunswick.

Subgeneric characters.—Teeth: $i.\ \frac{1-1}{1-1},\ p.\ \frac{0-0}{0-0},\ m.\ \frac{3-3}{3-3} = 16$. Skull stouter than in other subgenera; interorbital constriction greater; frontal region more swollen; middle molars equaling first in size. Enamel pattern of molars not essentially different from *Zapus*, but sulcus on inner side of upper molars deeper and persisting longer in the wearing tooth (fig. 2). General color pattern as usual in the genus, but tail tipped with white.

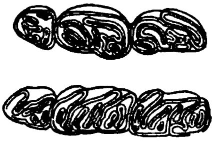

FIG. 2.—Molar teeth of *Zapus* (*Napæozapus*) *insignis* (topotype), from Restigouche River, N. B. (No. 2333, coll. E. A. and O. Bangs) × 6.

KEY TO SPECIES OF THE SUBGENUS NAPÆOZAPUS.

Hind foot less than 33 mm.; interorbital constriction usually more than 4.5 mm.
  Larger and lighter in color; hind foot usually more than 30 mm.; skull broader and stouter .... *insignis*.
  Smaller and darker; hind foot about 30 mm. or less; skull rather slender. *roanensis*.
Hind foot about 33 mm.; interorbital constriction narrow, usually less than 4.5 mm.; size large .... *abietorum*.

ZAPUS (NAPÆOZAPUS) INSIGNIS Miller. Woodland Jumping Mouse.

(Pl. I, figs 1, 1a.)

1856. ***Meriones labradorius*** Dawson, Edinburgh New Philos. Journ., new ser., III, p. 2.
1857. ***Jaculus hudsonius*** Baird, Mamm. N. Am., p. 430 (in part—specimen from Nova Scotia).
1877. ***Zapus hudsonius*** Coues, Mon. N. Am. Rodentia, p. 467 (in part).
1891. ***Zapus insignis*** Miller, Am. Naturalist, XXV, p. 472, August, 1891.

Type locality.—Restigouche River, New Brunswick.

Geographic distribution.—Canadian Zone in eastern Canada and south to western Maryland.

General characters.—Size rather large, larger than *Zapus hudsonius*, with longer ears and paler, more fulvous coloration. Tail tipped with white.

Color.—"Adult male No. $\frac{1656}{1462}$, collection of G. S. Miller, jr., Peterboro, N. Y., August 22, 1892; length, 250; tail vertebræ, 154; hind foot, 31.6; ear from notch, 18.6. Tip of tail for 23 mm., dorsum of manus and pes, and entire ventral surface pure white to base of hairs. Sides buff-yellow, tinged with clay color, except on cheeks, fore neck, and a narrow line bordering white of belly, where the yellow is noticeably purer; the fur plumbeous-gray at base and a trifle sprinkled with black, bristly hairs. These black hairs predominate on the back, where they form a sharply defined dorsal stripe slightly mixed with the color of the sides, broadest just back of the shoulders, tapering gradually to base of tail, and becoming indistinct on the head after passing between the ears. Ears externally concolor with back, internally buff-yellow; muzzle grayish-brown; whiskers mixed brownish and whitish, the longest hairs reaching beyond shoulders; tail thinly haired, so that the annulation shows distinctly, sharply bicolor, dark brown, except ventrally and at tip."[1] There is very little seasonal variation in this species, and the white of lower parts is never suffused with the color of sides.

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[1] *Napæozapus:* ναπᾶιος, belonging to a wooded vale or dell; + *Zapus*. This name was suggested to me by Mr. Gerrit S. Miller, jr.

Cranial characters.—Skull rather broad and stout; frontal region much swollen; brain case broad and rather flat; interorbital constriction broad as compared with that of all other species of the genus.

Measurements.—Nine specimens from Nova Scotia average: Total length, 238; tail vertebræ, 146.7; hind foot, 31.1. Sixteen from Peterboro, N. Y., average: Total length, 236; tail vertebræ, 147; hind foot, 30.25. One from Pocono Mountain, Pennsylvania: Total length, 224; tail vertebræ, 140; hind foot, 31. Two from Lake Hopatcong, New Jersey, average: Total length, 231; tail vertebræ, 140; hind foot, 31.5. *Skull:* Two skulls from type locality average: Basilar length, 18.7; zygomatic breadth, 12.3; mastoid breadth, 10.2; interorbital constriction, 4.9; incisor to postpalatal notch, 8.8; foramen magnum to postpalatal notch, 7.8; fronto-palatal depth at middle of molar series, 6. Four skulls from New York average: Basilar length, 19.6; zygomatic breadth, 12.9; mastoid breadth, 10.8; interorbital constriction, 5; incisor to postpalatal notch, 9; foramen magnum to postpalatal notch, 8.6; fronto-palatal depth at middle of molar series, 6.1.

General remarks.—Apparently the first published record which refers unmistakably to this species is that of Prof. J. W. Dawson, who, in 1856, in the Edinburgh New Philosophical Journal, called attention to the fact that two distinct species of Jumping Mice inhabited Nova Scotia. The present species he wrongly referred to *Meriones labradorius* (= *Zapus hudsonius*), and described true *Z. hudsonius* as a new species, calling it, provisionally, *Meriones acadicus*. In the National Museum are two specimens of *Zapus* deposited by Dawson; though mounted, they are in good condition for examination and are plainly referable respectively to *Z. insignis* and *Z. hudsonius*. Both Baird and Coues examined them, or at least similar specimens received from Dawson, but did not consider the two animals specifically distinct. *Zapus hudsonius* also occurs throughout the range of the present species, but the two prefer different situations—*Z. hudsonius*, shrubby fields and meadows, and *Z. insignis*, deep woods near streams.

This species presents remarkably little variation throughout its range. Specimens from central Pennsylvania, in the collection of Mr. S. N. Rhoads, are practically indistinguishable from examples taken near the type locality. Three specimens from Lake Hopatcong, N. J., have slightly smaller skulls than usual, but are otherwise perfectly typical. I have also examined two specimens from western Pennsylvania, collected by Mr. W. E. Clyde Todd, and have myself collected a specimen in the mountains at Finzel, in Garrett County, Md. None of these show any approach to *Z. insignis roanensis* from Roan Mountain, North Carolina. Mr. S. N. Rhoads writes me that he has also taken the species at Summit, Cambria County, Pa.

---

[1] G. S. Miller, jr., Proc. Biol. Soc. Wash., VIII, p. 2, 1893.

Specimens examined.—Total number, 107, from the following localities:

New Brunswick: Restigouche River (type locality), 3.
Nova Scotia: Halifax, 3; James River, 4.
Ontario: North Bay, 6.
New Hampshire: Antrim, 1; Chocorua, 8; Dublin, 3; Fabyans, 1; Franconia, 4; Profile Lake, 10.
Vermont: Mount Mansfield, 4.
Massachusetts: Mount Greylock, 1.
New York: Cascadeville, 4; Catskills, 4; Elizabethtown, 10; Glenville, 1; Lake George, 1; Peterboro, 30.
New Jersey: Lake Hopatcong, 3.
Pennsylvania: Cherry Spring, Potter County, 1; Eaglesmere, 2; Kingston, Westmoreland County, 1; Mount Pocono, 1.
Maryland: Finzel, Garrett County (6 miles north of Frostburg), 1.

ZAPUS (NAPÆOZAPUS) INSIGNIS ROANENSIS subsp. nov. Roan Mountain Jumping Mouse.

Type from Magnetic City, foot of Roan Mountain, North Carolina, No. 66283, ♂ ad., U. S. Nat. Museum, Biological Survey Coll. Collected May 22, 1894, by A. G. Wetherby.

Geographic distribution.—Known only from Roan Mountain, North Carolina.

General characters.—Smaller and darker than typical *Z. insignis*, with smaller, narrower skull.

Color.—Sides bright tawny ochraceous; entire upper parts, including ears, considerably darker than in typical *Z. insignis.* Beneath, pure white; amount of white on tail averaging less than in *Z. insignis.*

Cranial characters.—Skull similar to that of *Z. insignis*, but smaller and more slender throughout; mandible much more slender, especially in region of molars; interorbital constriction very slightly less; frontal region much less swollen; brain case narrower; fronto-palatal depth about the same.

Measurements.—Sixteen specimens from Roan Mountain average: Total length, 220; tail vertebræ, 131; hind foot (dry), 29.5. *Skull:* Six adult skulls from Roan Mountain average: Basilar length, 18.8; zygomatic breadth, 11.7; mastoid breadth, 10.1; interorbital constriction, 4.7; incisor to postpalatal notch, 8.8; foramen magnum to postpalatal notch, 8; fronto-palatal depth at middle of molar series, 6.2.

General remarks.—The collection of the Biological Survey contains 24 specimens of this form, collected from May to September. As in typical *Z. insignis*, there is very little seasonal variation. A young individual, about one-third grown, collected at the type locality September 11, 1892, by Dr. C. Hart Merriam, resembles adults in color, except that the dorsal area is very indistinct and the nose is white. Several of the type series, including this young one, have the white on the tip of tail reduced to the merest trace. While the material examined from Maryland and Pennsylvania shows no indication of intergradation existing between typical *Z. insignis* and the present form, I have thought best to give it a trinomial name in the belief that intergradation does exist.

Specimens examined.—Total number, 24, all from Roan Mountain, North Carolina.

ZAPUS (NAPÆOZAPUS) INSIGNIS ABIETORUM subsp. nov.

Northern Woodland Jumping Mouse.

Type from Peninsula Harbor, north shore of Lake Superior, Ontario, No. 4268, ♀ ad., collection of Gerrit S. Miller, jr. Collected Sept. 27, 1896, by Gerrit S. Miller, jr.

Geographic distribution.—Probably throughout Hudsonian zone in eastern Canada; limits of range unknown.

General characters.—Larger than typical *Z. insignis*, with shorter ears and peculiar skull.

Color.—Apparently not distinguishable from *Z. insignis.*

Cranial characters.—Compared with typical *Z. insignis* the skull of the type has molar series longer and heavier; interorbital constriction narrower than in any specimen of *insignis* examined; ventral border of pterygoids nearly on plane of palate; maxillary process of zygomata shorter and zygomata much less curved than in typical *insignis;* mandible much heavier.

Measurements.—Type: Total length, 255; tail vertebræ, 160; hind foot, 33; ear from meatus, 16.6. An adult male from Godbout, Quebec, measures: Total length, 250; tail vertebræ, 160; hind foot, 32.5. *Skull* (type): Basilar length, 19.4; zygomatic breadth, 12.2; mastoid breadth, 10.5; interorbital constriction, 4.3; incisor to postpalatal notch, 9.6; foramen magnum to postpalatal notch, 8.4; fronto-palatal depth at middle of molar series, 6.

General remarks.—This form is based mainly on a single specimen, collected at Peninsula Harbor, Ontario, on the north shore of Lake Superior, in the Hudsonian zone, by Gerrit S. Miller, jr. Mr. Miller recorded this specimen[1] and described its peculiarities in some detail. A specimen in the Bangs collection, from Lake Edward, Quebec, and two from Godbout, Quebec, in Dr. Merriam's collection, while not perfectly typical, agree with the type in large size, narrow interorbital constriction, and in other peculiarities. This makes it probable that this form will be found to occur throughout the Hudsonian zone, in eastern Canada. The specimen of *Z. insignis*, recently recorded from Labrador by Mr. Outram Bangs,[2] which he thinks is not typical, may belong to this form. The type of *abietorum* is slightly larger than the largest specimens examined of the typical form, while the ear is slightly shorter than usual.

---

[1] Notes on the Mammals of Ontario <Proc. Boston Soc. Nat. Hist., XXVIII, No. 1, p. 10, April, 1897.

[2] Am. Naturalist, XXXII, No. 379, p. 493, July, 1898.

Specimens examined.—Total number, 4, from the following localities:

Ontario: Peninsula Harbor, 1 (type).
Quebec: Godbout, 2; Lake Edward, 1.

EOZAPUS[1] subgenus novum.

Type Zapus setchuanus Pousargues, from Szechuen, China.

Subgeneric characters.—Teeth: $i. \frac{2}{2}$, $p. \frac{1-1}{0-0}$, $m. \frac{3-3}{3-3} = 18$. Skull similar to those of the subgenera *Zapus* and *Napæozapus*, but differing as follows: Skull relatively broader, shorter, and lower; nasals broad, distinctly forked posteriorly; antorbital foramina rather large; incisive foramina medium; posterior palatine foramina midway between incisive foramina and postpalatal notch, the latter barely reaching posterior plane of molars. Rostrum relatively shorter and broader; zygomata relatively shorter, with jugal portion almost perfectly straight, frontal region less swollen. Enamel pattern of molars somewhat similar, but enamel folds not closely crowded; last lower molar relatively larger (fig. 3). Color pattern differing from that of other subgenera in having a brown ventral stripe; tail tipped with white, as in *Napæozapus*.

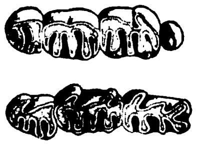

FIG. 3.—Molar teeth of *Zapus (Eozapus) setchuanus* (cotype), from Ta-tsien-lou, Szechuen, China. × 6.

ZAPUS (EOZAPUS) SETCHUANUS Pousargues. Szechuen Jumping Mouse.

(Pl. I, figs. 2, 2a.)

Zapus setchuanus Pousargues, Ann. Sci. Nat., 8e sér., I, No. 4, p. 220, Avril, 1896; Bull. Mus. d'Hist. Nat., Paris, II, p. 13, figs. 1-3, 1896.

Type locality.—Ta-tsien-lou, Szechuen, China.

Geographic distribution.—Known only from the type locality.

General characters.—Differing from all other known members of the genus in having a ventral stripe of brown.

Color.—Upper parts dark, tawny ochraceous; dorsal area sharply defined and very thickly flecked with black-tipped hairs, the sides moderately lined with same. Pattern of color above as in the American species. Beneath white, suffused with ochraceous, the white nearly obsolete on fore breast; a brownish stripe about 5 mm. wide extends the entire length of breast and belly; feet, chin, and lips white; tail strongly bicolored; brownish above and whitish beneath, with about 15 mm. of the tip pure white; ears dusky.

Cranial characters.—Compared with *Z. hudsonius* the skull of *setchuanus* differs as follows: Interorbital constriction relatively narrower;

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[1] Eozapus: ἠώς, dawn, ι. ε. eastern; + *Zapus*.

frontal region less swollen; rostrum shorter and less attenuated; zygomata shorter, the maxillary portion more nearly perpendicular to main axis of skull, the jugal portion heavier and nearly straight; palate longer, the postpalatal notch not quite reaching posterior plane of molars (in American species commonly exceeding that point); nasals prolonged farther posteriorly and forking (in American species generally irregularly truncated); bullæ larger; the coronoid process of mandible not ascending so high, but longer, broader, and straighter, and the coronoid notch deeper and less rounded than in *Z. hudsonius* (fig. 4).

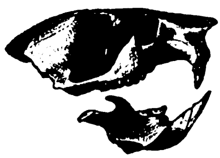

FIG. 4.—Skull of *Zapus* (*Eozapus*) *setchuanus* (cotype) from Ta-tsien-lou, Szechuen, China. × 1¼.

Measurements.—The following measurements from Pousargues will serve for comparison with other species: 'Vieux,' head and body, 100; tail, 120; foot, 31; 'adulte,' head and body, 80; tail, 103; foot, 30; 'semiadulte,' head and body, 70; tail, 95; foot, 28. Skull No. 2:[1] Zygomatic breadth, 11.6; interorbital constriction, 3.6; incisor to postpalatal notch, 8.5; fronto-palatal depth at middle of molar series, 5.5. No. 3: Zygomatic breadth, 11.5; interorbital constriction, 3.8; incisor to postpalatal notch, 8.2; fronto-palatal depth at middle of molar series, 5.6.

General remarks.—This very interesting species was described from three skins in alcohol accompanied by imperfect skulls. Its describer, M. E. De Pousargues, discusses its color and other peculiarities in considerable detail, and presents a table showing the measurements of the three specimens, together with the corresponding measurements of a specimen of *Z. hudsonius*, taken from Coues. These measurements of *hudsonius* (head and body, 85; tail, 135; foot, 27), if all from one individual, must have been taken from a distorted specimen and do not give a fair idea of the proportions, the foot measurement, 27 mm., being evidently too small for an animal with the tail measuring 135. On this account the proportional differences between *setchuanus* and *hudsonius* are exaggerated. Through the courtesy of Mr. Gerrit S. Miller, jr., I have been able to examine two of these skins and the skulls, generously loaned to him by M. Pousargues. The color of these skins is apparently not much changed by the action of alcohol. The brown ventral stripe and comparatively short, hairy tail with its white tip, constitute the most striking peculiarities. The hind foot is about the same size as in *hudsonius;* the ear shorter and broader than in the American species.[2] As already stated, the skulls are all imperfect.

---

[1] These numbers are provisional, and owing to the imperfect condition of the skulls only these measurements could be taken.

[2] The following table will serve to show the approximate ratio of width to height of ear in *Zapus insignis*, *Z. hudsonius*, and *Z. setchuanus* (alcoholic specimens):

	Z. insignis. Two specimens.		*Z. hudsonius.* Two specimens.		*Z. setchuanus.* Two specimens.	
	Male.	Female.	Male.	Female.	Larger.	Smaller.
Height of ear from notch	15.5	15.5	14	14	12.5	11
Greatest width of ear	9	9	9	9	10	9

The largest is so badly crushed as to be almost worthless, and the two smaller ones lack the occipital portion of the cranium and the posterior parts of the mandibles, the shape of the angular process, therefore, being unknown. This species has the small upper premolar as in the subgenus *Zapus*, that tooth being larger than in *Z. hudsonius*. The last lower molar is also proportionately larger. All the molars differ from those of any American species in having the enamel folds not closely crowded, the resulting wide and deep sulci giving the teeth a very different appearance, though the general pattern of enamel folding is perhaps not essentially different. The incisors are lighter in color than in the American species.

Specimens examined.—Two skins and three skulls, from the type locality.

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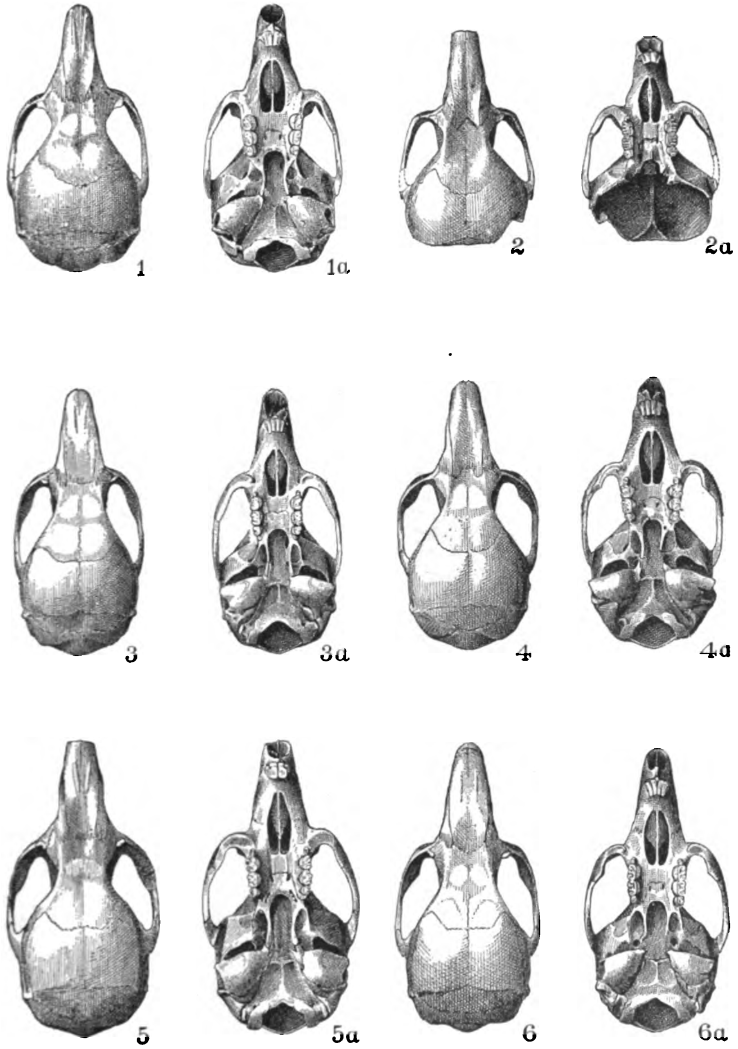
PLATE I.

(One and one-half times natural size.)

FIG. 1. *Zapus* (*Napæozapus*) *insignis* Miller (Type). Restigouche River, New Brunswick.
(Type $\frac{387}{464}$, Miller collection.)
2. *Zapus* (*Eozapus*) *setchuanus* Pousargues (Cotype). Ta-tsien-lou, Szechuen, China.
3. *Zapus* (*Zapus*) *hudsonius* (Zimmermann). James Bay, Canada.
(No. 60588, U. S. Nat. Mus.)
4. *Zapus* (*Zapus*) *orarius* Preble (Type). Point Reyes, Calif.
(No. 250, Collection E. A. & O. Bangs.)
5. *Zapus* (*Zapus*) *trinotatus* Rhoads. Port Moody, British Columbia.
(No. 66928, U. S. Nat. Mus.)
6. *Zapus* (*Zapus*) *princeps* Allen (Topotype). Florida, La Plata County, Colo.
(No. 4139, Am. Mus. Nat. Hist.)



SKULLS OF ZAPUS.

1. ***Zapus insignis.***
2. ***Z. setchuanus.***
3. *Z. hudsonius.*
4. *Z. orarius.*
5. *Z. trinotatus.*
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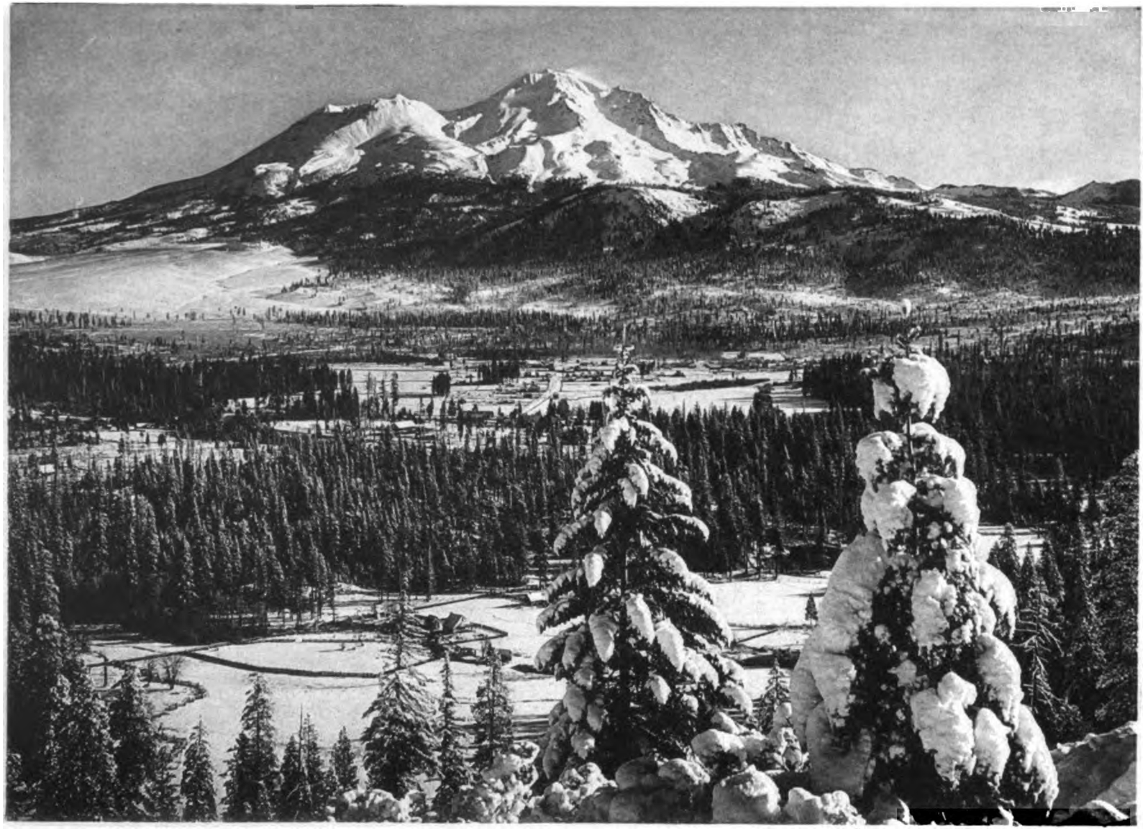

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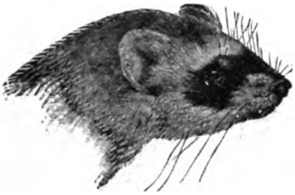
MOUNT SHASTA FROM THE NORTHWEST.

U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 16

[Actual date of publication, October 28, 1899]



RESULTS OF A BIOLOGICAL SURVEY OF MOUNT SHASTA CALIFORNIA

BY

C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

1862 1889

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF BIOLOGICAL SURVEY,
Washington, D. C., May 19, 1899.

SIR: I have the honor to transmit herewith for publication, as North American Fauna No. 16, a report on the results of a Biological Survey of Mount Shasta, California, made during the summer of 1898.

Respectfully,

C. HART MERRIAM,
Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

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No. 16. NORTH AMERICAN FAUNA. October, 1899.

RESULTS OF A BIOLOGICAL SURVEY OF MOUNT SHASTA, NORTHERN CALIFORNIA.

By C. HART MERRIAM.

INTRODUCTION.

At the close of the field season of 1897 the Biological Survey had nearly completed a reconnoissance of Washington and Oregon, and in previous years had carried its operations over extensive tracts in southern, middle, and northeastern California, so that with the exception of a rather large area in northern California fully two-thirds of the Pacific States had been covered. In 1898, therefore, the unworked part of northern California, reaching from the Madeline Plains on the east to the Pacific Ocean on the west, and from the Oregon boundary on the north to Lassen Butte and adjacent parts of the Sierra on the south, came to be the principal field of our investigations. In this area Mount Shasta occupies a nearly central position.

All high mountains, particularly those that stand alone, are likely to throw light on the problems of geographic distribution and are worthy of careful study. Shasta, not only because of its great altitude, but even more because of its intermediate position between the Sierra and the Cascades, promised an instructive lesson, and was therefore chosen as a base station for part of the field work of 1898.

From work previously done in the Sierra Nevada of California and the Cascade Range of Oregon it was known that many species of animals and plants are common to both ranges, and many restricted to one or the other. Shasta, lying between the two, was expected to share the common features of both, and in addition afford the northernmost limit of Sierra species, the southernmost limit of Cascade species, or an overlapping of both, so that its fauna and flora, other things being equal, should be richer than either. But Shasta proved very much drier than either the Sierra or the Cascades, and consequently many species common to the two ranges were absent, and the total number was less than was expected. Nevertheless, the mountain shares a large percentage of the common species and is, as expected, a stepping stone on which restricted Sierra and Cascade species overlap. But the representatives of the two ranges are not equally apportioned. The most evident gap is on the north, Shasta sharing many more species in common with the Sierra than with the Cascades. Indeed, the resemblance to the northern Sierra is so exceedingly close, particularly in the mammal fauna, that from the standpoint of geographic distribution Shasta could without violence be classed as part of the Sierra. This is the more surprising in view of the fact that the geographical gap between Shasta and the Cascades is only half as broad as that between Shasta and the Sierra. This subject is discussed in detail in the chapters entitled 'The Boreal fauna and flora of Shasta contrasted with corresponding faunas and floras of the Sierra and the Cascades;' 'Efficiency of Klamath Gap as a barrier to Boreal species compared with that of Pitt River and Feather River gaps collectively,' and 'Sources of the Boreal faunas of Shasta and of the Sierra and the Cascades.'

ITINERARY.

Leaving the railroad at Sisson, at the west base of Shasta, we established the first camp July 15, 1898, at a point known as Wagon Camp, on the south slope of the mountain, about a quarter of a mile west of Panther Creek, at an altitude of 5,700 feet (fig. 1). Wagon Camp is situ-

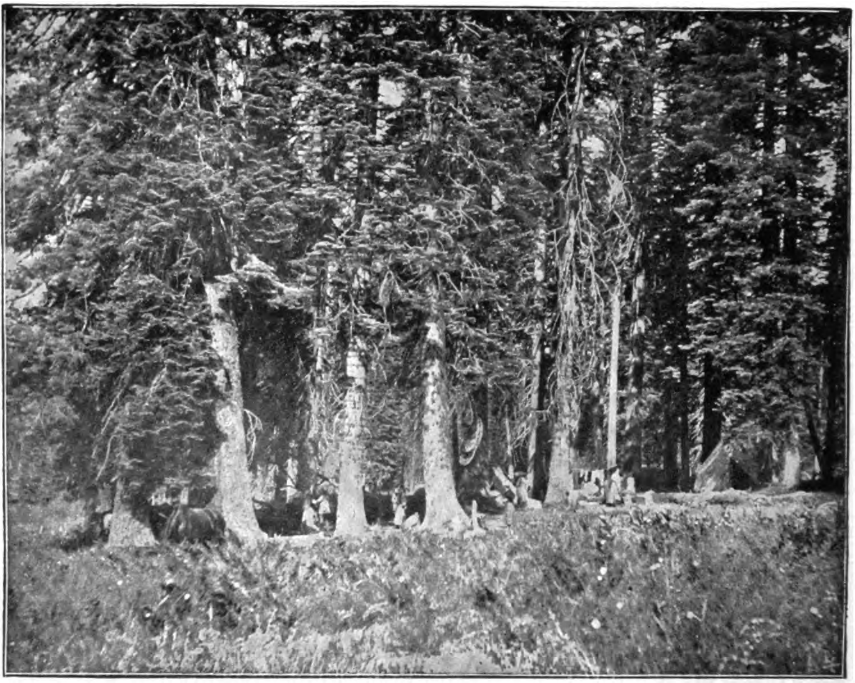

FIG. 1.—Wagon Camp.

ated in a descending tongue of Shasta firs between ascending tongues of manzanita chaparral, just above the uppermost grove of ponderosa pines, on the boundary between the Canadian and Transition zones. It is abundantly supplied with water from several small springs, from which tiny streamlets run short distances before disappearing in the thirsty soil. Some of these springs unite to form a small marsh, in which flourish a number of plants not found elsewhere on the mountain. It is naturally a favorite spot for birds, and more species were seen here than elsewhere. Wagon Camp was occupied continuously by one or more members of the party from July 15 to August 1, and at brief intervals thereafter until October 3.

A few days after reaching the mountain I set out on a trip around the peak in order to become familiar with the general features of the region and lay plans for the season's work. On this trip I was accompanied by Vernon Bailey, my most experienced field assistant, and by a voluntary assistant, Lyman L. Merriam. We took saddle horses and a pack animal, which were of material aid, although we had much difficulty in getting them across some of the deep canyons and over the indescribably rough lava on the west side of the mountain.

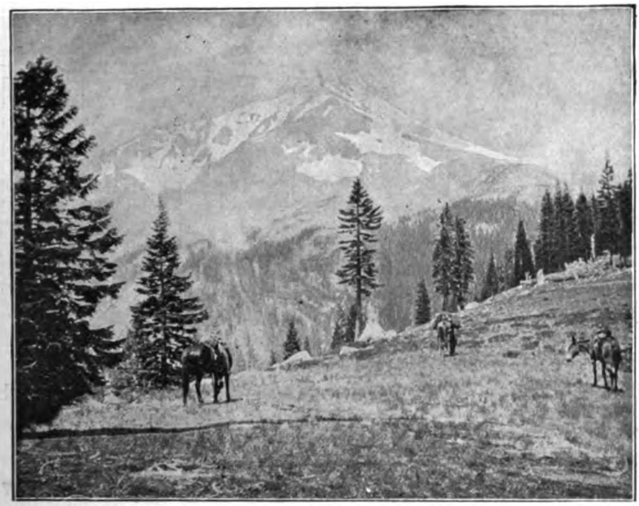

FIG. 2.—Shasta from east brink of Mud Creek Canyon.

Leaving Wagon Camp on the morning of July 22, we ascended Panther Creek to its source, turned easterly through 'The [South] Gate,' north of Gray and Red buttes, crossed Squaw Creek near its head, and kept on among the timberline white-bark pines to the rim of Mud Creek Canyon (pl. III), which we followed down into the Shasta firs. The first night was spent in the bottom of this canyon at an altitude of 5,600 feet—some distance below the lower fall. The second day we climbed the steep east bank of the canyon, here 1,000 feet deep (fig. 2), crossed Cold Creek and Ash Creek Canyon below timberline, and reached

Brewer Creek Canyon in the upper part of the white-bark pines. Finding absolutely no grass or other feed for the animals here, we crossed the canyon lower down (a little below the forks) and continued on over rough lava ridges in the upper edge of the forest until dark, when we camped on Inconstance Creek (fig. 3). The third day we pushed on around the north end of the mountain, keeping a little below the great glaciers, and in the main near timberline. We climbed over a number of lava ridges, availed ourselves of a natural passageway ('North Gate') at the upper end of a pair of conspicuous lava buttes, traversed a curious pumice plain covered with timberline mats of prostrate white-bark pines (fig. 22), crossed the fearful canyons of Whitney and Bolam creeks, and finally reached Shastina, where, after a very severe day, we camped on some small streams of snow water on the north side (fig. 4). The fourth morning we climbed the rough slide rock of Shastina to an altitude of 10,000 feet, in order to get around a high impassable lava ridge, and then, after encircling a great amphitheater of rough slide rock, descended by some immense masses of perpetual snow to the white-bark pines, in which we continued to the great canyon on the west side of Shastina (pl. II), which I named Diller Canyon, in honor of J. S. Diller of the U. S. Geological Survey, in recognition of his admirable researches on the geology of Shasta. After crossing Diller Canyon we kept in the upper part of the Shasta fir forest all the way to Panther Creek, which we followed down to Wagon Camp. This

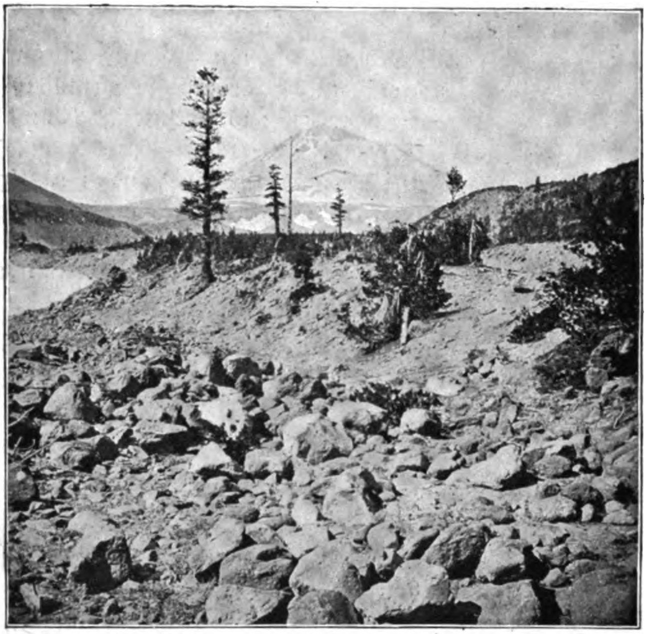

FIG. 3.—Shasta from Inconstance Creek, near timberline on north side.

was the most trying day of all—sixteen miles of continual climbing, removing blocks of lava, and building trail. Our animals suffered severely, and one of them gave out entirely. However, the mountain was completely encircled after four long days, and the desired information was obtained. In the main we kept near timberline, climbing over the bare rock slopes above, or descending into the dark forest below,

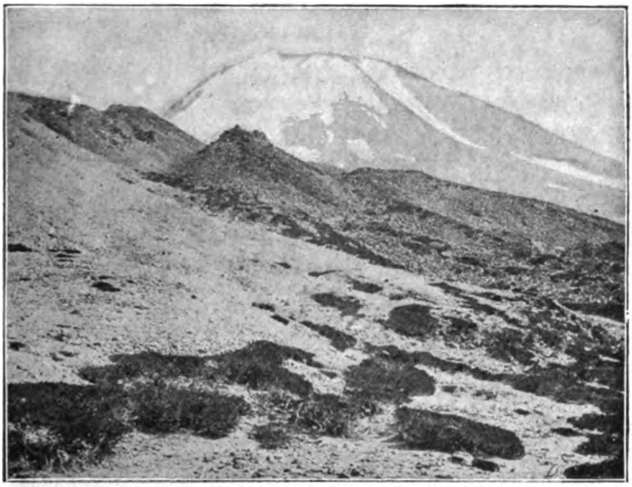

FIG. 4.—Shastina from north, showing great bank of snow which feeds Shastina streams.

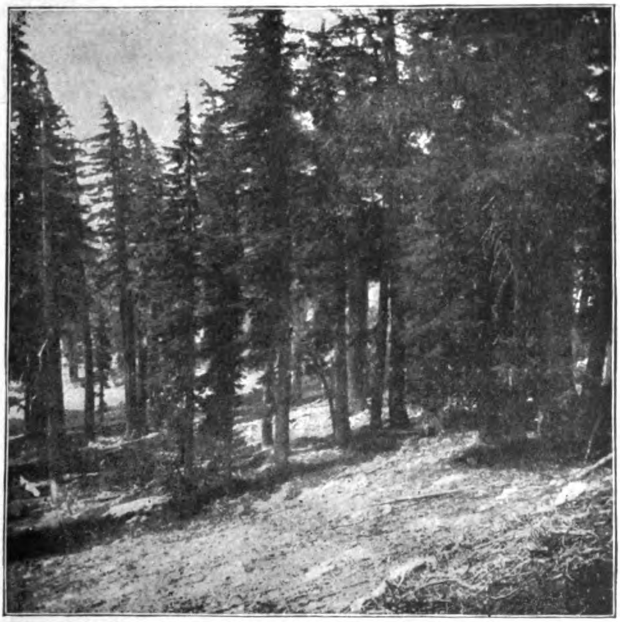

FIG. 5.—Alpine hemlocks, Squaw Creek Camp.

as occasion required. And since all the canyons of Shasta radiate from the summit, all were crossed on this trip.

A base camp was next established in a grove of black alpine hemlocks near the head of the west branch of Squaw Creek, close to and just east of the upper end of Red Butte. Here one or more of the party remained continuously from August 1 till September 24. All things considered, this is probably the best camping ground on Shasta, though I am not aware that it had been used before our visit. It is close by the three upper 'meadows' on Squaw Creek and within reach of the best feed for horses found on the mountain, with the possible exception of a small area near Cold Creek, and it is by far the most convenient base from which to work the timberline region of the southern slopes.

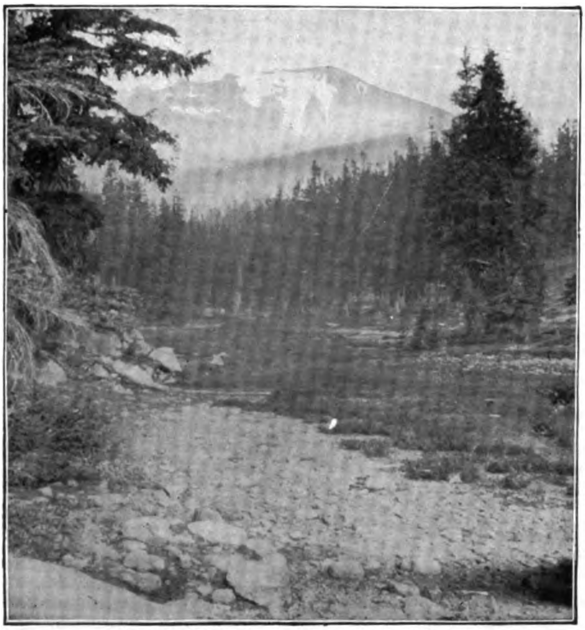

FIG. 6.—Heather meadow on Squaw Creek.

Temporary camps were established at the head of Panther Creek, in Mud Creek Canyon at the mouth of Clear Creek, in Ash Creek Canyon a little below timberline, and high up between Mud Creek Canyon and the head of Clear Creek, from which point the main peak was twice ascended. At the base of the mountain, work was done at Sisson on the west side, in Squaw Creek and McCloud valleys on the south, and in Shasta and Little Shasta valleys on the north, and finally a trip was made completely around the mountain, mainly within the belt of yellow pines which clothes its lower slopes.

PERSONNEL.

In the field work on which the present report is based, I was aided by Vernon Bailey, chief field naturalist of the Biological Survey, and my assistants, Wilfred H. Osgood, Walter K. Fisher, and Richard T. Fisher. Vernon Bailey had charge of the work at the Shasta base camps and on a trip around the base of the mountain; Walter K. Fisher had charge of the work in Mud Creek and Ash Creek canyons and near timberline east of Mud Creek, and afterwards took a party to Fall River Lake and Lassen Butte; W. H. Osgood had charge of the work on Lassen after Walter Fisher's departure, and also visited Squaw Creek and Shasta and Little Shasta valleys; R. T. Fisher spent the season working from the various camps on Shasta and at Sisson, and accompanied Osgood on the trip to Little Shasta Valley.[1]

Our camps on Shasta were visited by Henry Gannett, chief geographer of the U. S. Geological Survey; John H. Sage, of Connecticut, secretary of the American Ornithologists' Union; and two or three others, all of whom rendered important assistance.

In addition to the work on and near Shasta covered by the present report, field work was done in various directions. Three cross sections of the Sierra Nevada, north of latitude 39°, were made by Bailey, Osgood, and myself; Bailey and Walter Fisher ran a line from Black Rock Desert, Nevada, to Shasta, by way of Madeline Plains; Bailey and I, accompanied by Henry Gannett, carried the work across the wild and little known mountains from Shasta to the ocean, which we reached at Humboldt Bay; and later in the season much work was done farther south, chiefly in the inner and outer Coast Ranges.

PREVIOUS PUBLICATIONS.

Only two publications have been found relating to the zoology and botany of the Shasta region. The first is a report by Charles H. Townsend, of the U. S. Fish Commission, who, fifteen years before our visit, was stationed at Baird, a fish hatchery on McCloud River. While there Mr. Townsend visited Berryvale (now Sisson Tavern) and accompanied Major Gilbert Thompson, who was in charge of a triangulation party of the U. S. Geological Survey, in his field work on Shasta. The results of Mr. Townsend's work are contained in an important report entitled 'Field Notes on the Mammals, Birds, and Reptiles of Northern California,' published in the fall of 1887.[2] In addition to the records in this report, Mr. Townsend has kindly placed his manuscript catalogue at my disposal, and has in several instances given me important supplementary information respecting the exact localities at which specimens were collected, all of which is duly credited in the body of the present report.

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[1] While this report was passing through the press (July, 1899), I sent Walter K. Fisher to Mount Shasta and Shasta Valley to obtain supplemental information, some of which is incorporated in the mammal, bird, and plant reports at the end.—C. H. M.

[2] Proc. U. S. National Museum, X, pp. 159–241, Nov., 1887.

The second publication referred to is a brief paper by Miss Alice Eastwood on 'The Alpine Flora of Mount Shasta,'[1] containing the results of a hasty trip to the summit made in August, 1893.

So far as I have been able to ascertain, this is the first and only publication relating directly to Shasta plants, although a number of species collected there during a brief visit by Prof. Wm. H. Brewer in the early sixties are mentioned in the Botany of California (by Brewer and Watson, 1876–1880).

NEW SPECIES.

In working up the collections it was found that several of the plants and mammals belonged to undescribed species. Some of the new plants have been described by Prof. E. L. Greene;[2] others remain unnamed. The new mammals are here described. The new species are:

Plants.

Agoseris monticola.
Arnica merriami.
Campanula wilkinsiana.
Phacelia frigida.
Pyrola pallida.

Mammals.

Lepus klamathensis.
Lynx fasciatus pallescens.
Neurotrichus gibbsi major.
Procyon psora pacifica.
Reithrodontomys klamathensis.
Sorex shastensis.
Thomomys monticola pinetorum.
Urocyon californicus townsendi.

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[1] Erythea, IV, No. 9, pp. 136–142, Sept., 1896.

[2] Pittonia, IV, pp. 36–40, March 17, 1899.

GENERAL FEATURES OF SHASTA.

The snowy peak of Shasta, the pride of California, is one of the highest and most accessible of the snow-clad glacier-bearing mountains of the United States. It is an old volcano, 14,450 feet in altitude, and is completely cut off from neighboring mountains—from Lassen Peak, at the north end of the Sierra proper, by the valleys of the McCloud and Pitt rivers; from the south end of the Cascade Range in Oregon by a broad lava plateau and the valley of Klamath River. The breadth of the gap on the north is diminished by a cluster of low volcanic mountains known as the Goose Nest Group.

Shasta is the best-known landmark in California. Seen from the north, south, and east it appears as a single cone pushing its lofty crown upward six or seven thousand feet above apparent timberline. Seen from the west and southwest its summit is elongated and looks more like the crest of a ridge (frontispiece). This appearance is due in part to a large secondary volcano, Shastina, which rises from the northwest shoulder of the mountain, and in part to a long ridge which pushes out to the south. This west side, the one seen by tourists in traveling over the Shasta route from San Francisco to Portland, is in many respects the least interesting. From its exposure to the direct rays of the afternoon sun it is the hottest slope, and consequently the one on which timber reaches highest and on which the ice and snow are most reduced.

Like most isolated mountains, Shasta is seen to best advantage from a distance. The most imposing view to my mind is from the northeast, the region of the Modoc lava beds, from which the peak looms up in all its icy grandeur—a single massive cone buried from top almost to bottom in continuous glaciers, below which it is encircled by a dark belt of coniferous forest. It is also very imposing as seen from the distant Trinity Mountains.

The north and east sides of the peak are completely, and the south side partly covered by glaciers, but not a glacier is to be found on the west, where the large masses of white seen from Sisson are banks of snow, more or less permanent. The only glacier visible from the railroad is Whitney Glacier, which occupies the notch between Shasta and Shastina, and may be seen from points north of Edgewood. The higher slopes, between the lower edge of the ice and snow and the upper edge of the forest, are steep and rocky. In the main they consist of radiating ridges alternating with glacial basins and precipitous canyons. As a rule the surface is light pumice and pumice sand thickly strewn with fragments of gray volcanic rock, interrupted here and there by masses and cliffs of darker lava, often reddish brown in color.

The south and east sides, except the deep canyons of Mud, Ash, and Brewer creeks, are fair traveling for mountain horses. The north side, below the great glaciers, is interrupted by exceedingly rough lava ridges and the terrible canyons of Bolam and Whitney creeks. The west side, though scored by only a single notable canyon—Diller Canyon (pl. II)—is by far the most difficult. After crossing the tremendous slopes of steep and sharp slide rock, very dangerous for horses, on the northwest side of Shastina, and surmounting the two principal lava ridges west of Shastina Creek, the way to Diller Canyon is comparatively easy. But between Diller Canyon and Cascade Gulch, a mile or so north of Horse Camp, and extending from timberline downward several thousand feet, is a chaos of lava the like of which I have never seen. It suggests the worst parts of the Snake River and Modoc lava beds turned up on end—basins, ridges, and tumultuous piles without order or direction, without beginning or ending—dry basins that empty nowhere, drier ridges that lead nowhere, until one is worn out with thirst and efforts to escape. The whole is hidden in a dark forest of Shasta firs whose hardy trunks force themselves out between the lava blocks in ways that almost surpass belief. Finally all this stops as suddenly as it began, and one emerges from the dark inferno to slake his thirst in the refreshing pools of Cascade Gulch—known only to the deer—and, with a sense of infinite relief, reenters the area of pumice sand and gray shale which stretches away to the southeast and thence onward around three-quarters of the mountain.

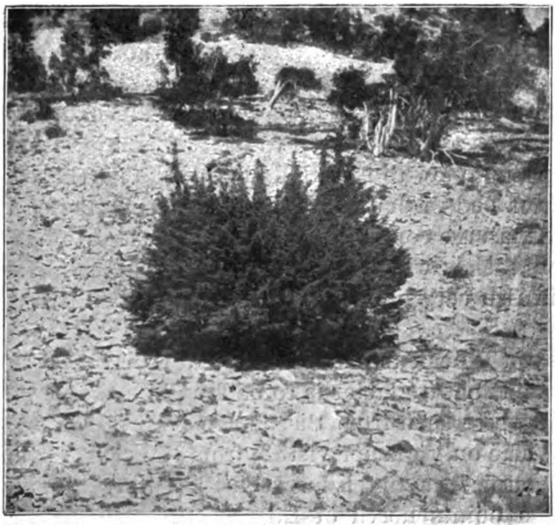
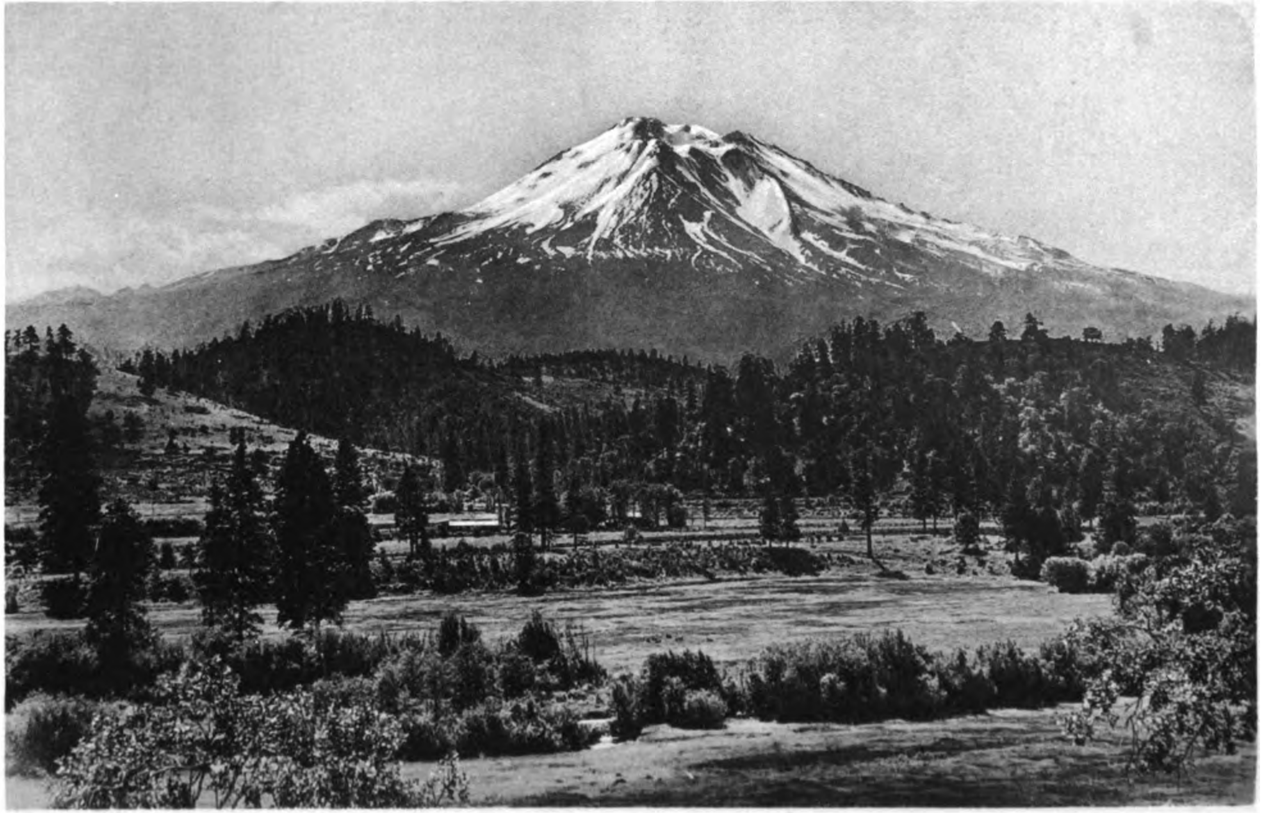


FIG. 7.—Pumice sand strewn with gray volcanic shale. Young hemlocks in foreground; white-bark pines in distance.

The timbered valley at the west base of Shasta falls away both to the south and to the north. On the south it drains immediately into the Sacramento River; on the north into the Shasta River, which traverses Shasta Valley and empties into Klamath River. Shasta Valley is an open plain northwest of the mountain; it is lowest at the north, and its northwestern corner ends in a pocket or basin containing the mining town of Yreka, which is doubtless the hottest part of northern California west of the axis of the Sierra-Cascade system.



THE HELIOTYPE PRINTING CO., BOSTON

MOUNT SHASTA FROM THE NORTHWEST, SHOWING GREAT SNOWBANK IN HEAD OF DILLER CANYON.

EFFECTS OF SCANTY MOISTURE.

The flora of Shasta, contrasted with that of moister mountains immediately north and immediately south, is poor in species and individuals; and the same is true in less degree of the fauna. At least nineteen characteristic genera and numerous additional species of plants common to the Sierra and the Cascades, are unknown (p. 80); and to these must be added the distinctive species of each range which fail to reach Shasta. The luxuriant mountain meadows and flower beds that form such conspicuous features of the timberline region in the Cascades, the Olympics, the High Sierra, and the Rocky Mountains are wholly absent, and the only areas that in any way resemble them are the insignificant patches of mountain heather and accompanying plants that carpet the moist bottoms of the glacier basins and form narrow beds along the tiny streams, where they are concentrated by the local distribution of soil moisture. The only real soil above timberline is restricted to the borders of the streamlets, where the decomposing heather has left a shallow covering. Everywhere else are pumice, broken lava, and barren cliffs.

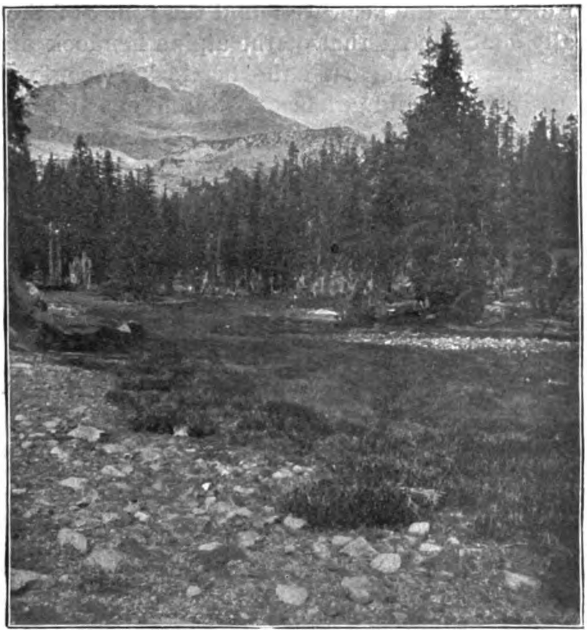


FIG. 8.—Heather meadow bordering Squaw Creek. Shasta peak in distance covered with fresh snow, September 22, 1898.

The summer rainfall amounts to little or nothing, and when rains occur they sink and vanish in the thirsty pumice sand. The streams from melting snows are exceedingly small, averaging hardly more than a foot or two in width, and most of them disappear before reaching the base of the mountain. The turbid streams from the glaciers are larger, but they have cut for themselves deep gorges where they run their rapid courses 1,000 feet below the surface, and consequently are useless for purposes of general irrigation. They exert a local influence, it is true, since far down in the damp bottoms of the canyons and along their cool easterly lower slopes a number of moisture-loving plants occur that are not found elsewhere except about the few and widely scattered springs in the forest—serving by contrast to accentuate the general aridity. Even the black alpine hemlock, which in the Cascades forms so attractive a feature of the upper slopes, is of local occurrence on Shasta, where its distribution is interesting as furnishing an index to soil moisture. It is associated with the white-bark pine (*Pinus albicaulis*), which requires less moisture and is the dominant timberline tree. In our circuit of the peak we found the range of the white-bark pine practically continuous; that of the alpine hemlock discontinuous and greatly restricted. As a rule the hemlock is confined to narrow strips along the streams and gulches, or to tongues along the cool east sides of buttes and ridges, where the soil, sheltered from the hot afternoon sun, is able to retain more moisture than elsewhere. Below the alpine hemlocks and occupying the middle belt of the mountain is a magnificent forest of Shasta firs; but the humbler vegetation of this belt is scanty and irregular.

From what has been said it is obvious that excessive dryness prevents many of the characteristic zone species from filling their appropriate belts, restricting them to scattered spots, where, as in the desert, succulent vegetation is concentrated about springs and streams. Hence Shasta is a poor place to study the broad general facts of zone distribution, but, as shown later, an admirable place to study detailed effects of slope exposure and humidity.

GLACIAL BASINS.

As in most parts of the Sierra and many parts of the Cascades, glacial basins are conspicuous on the higher slopes of the mountain. They occupy the deep depressions between the radiating ridges, and their terminal moraines are usually clearly defined. In some of the valleys, as along the upper part of Squaw Creek, two or three such moraines may be found at intervals, marking successive stages in the retreat of the glacier. The glacial basins usually contain small streams, at least during spring and early summer, and they receive additional moisture from the melting snows, which linger long in the shadows of the ridges. This moisture permits the growth of a more abundant vegetation than occurs elsewhere on Shasta, save only along the streams. The bottoms of the basins therefore are usually carpeted with red heather (*Bryanthus* or *Phyllodoce empetriformis*) and a variety of small plants, the majority of which are inconspicuous except when in flower. Among the most noticeable of these, each contributing its mite to the general verdure of the heather beds, are the dwarf huckleberries, white alpine antennarias, silenes and ligusticums, yellow monkey flowers, violets and hieraciums, blue veronicas and asters, cream-colored feathery lutkeas and parnassias, pink epilobiums, red alpine laurels, and scarlet painted cups.[1] True grasses are scarce, but grass-like carices abound.

The mammals inhabiting the heather meadows are the rare alpine phenacomys (*Phenacomys orophilus*), the white-footed mouse (*Peromyscus gambeli*), the long-tail mountain vole (*Microtus mordax*), and the Sierra pocket gopher (*Thomomys monticola*). The gophers throw up their characteristic mounds about the edges of the heather beds but are commoner on the adjacent pumice slopes.

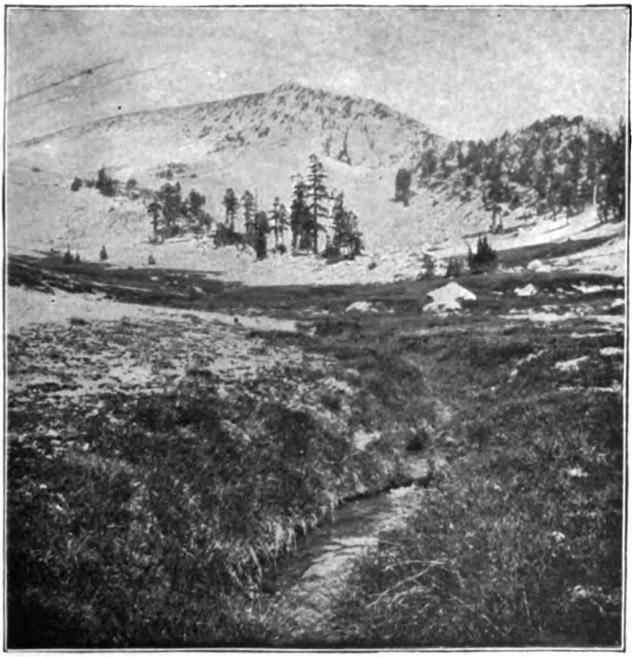


FIG. 9.—Glacial meadow at head of Squaw Creek.

CANYONS.

All the canyons of Shasta radiate from the ice-covered summit and take remarkably straight courses down the steep sides of the mountain. Most of them are profound gorges cut by swift-flowing glacial streams. They average about a thousand feet in depth, and their slopes are as steep as permitted by the unstable material through which they are cut—usually pumice, gravel, and fragments of lava. Owing to the fact that all of the great glaciers are on the north, east, or southeast sides of the mountain, the canyons made by their rivers are necessarily on these sides also. The only one of any size which does not come from a glacier is Diller Canyon, on the west side of Shastina.

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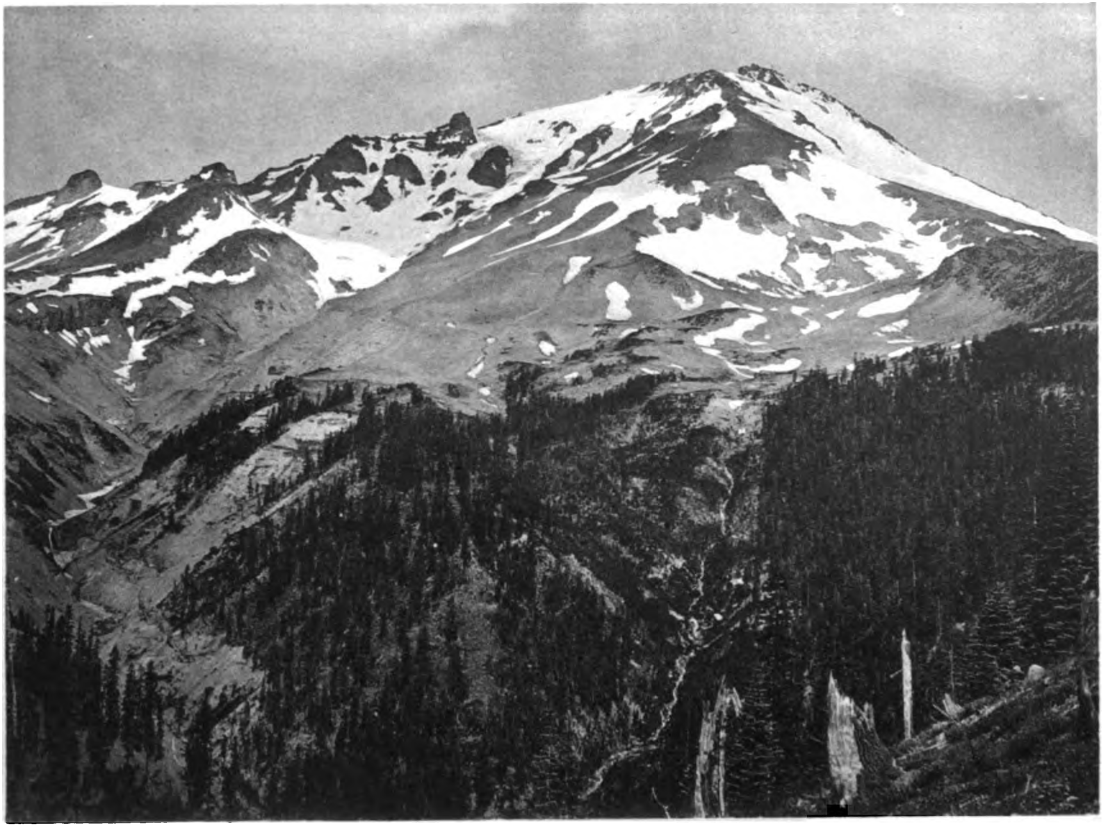
[1] The plants of the glacial basins in the timberline region vary somewhat with the moisture of the soil. The commonest species in moist spots and along the borders of the streamlets are: *Arnica merriami, Castilleja miniata, Epilobium clavatum, Hieracium gracile, Hypericum anagalloides, Mimulus implexus* (growing in the water), *Mimulus primuloides, Mitella pentandra, Parnassia californica, Veronica cusicki.* The commonest species in the drier parts of the heather beds are: *Antennaria media, Castilleja miniata, Hieracium gracile, Kalmia glauca microphylla, Lutkea pectinata, Ligusticum grayi, Phyllodoce empetriformis, Sibbaldia procumbens, Silene grayi, Vaccinium cæspitosum, Viola purpurea.*

In most, if not all, cases the bottoms of the canyons in their upper courses are bridged for long distances by masses of ice and snow—the dumps of avalanches. Below these snow bridges are vast accumulations of loose stones, which in several instances, as in Brewer, Bolam, and Whitney canyons, are piled up in a curious manner. During periods of high water the rocks that fall in are carried down by the torrent and deposited on each side in banks several feet high, so that the traveler on reaching the bottom has to climb up over a ridge of loose stones and down again before coming to the stream. These lateral ridges form miniature canyons in the bottoms of the big ones. Most of the canyons have falls several hundred feet high in their upper courses, and some have other falls farther down. Notable falls are found high up in the canyons of Mud Creek, Ash Creek, Bolam Creek, and Whitney Creek. While difficult of access, they are well worth the effort of a visit.

Mud Creek Canyon (pl. III), the only one likely to be seen by the ordinary visitor to Shasta, is not easy to cross except near the mouth of Clear Creek, which comes into it from the east. Its east bank is a precipitous single slope about 1,000 feet in height. Its west bank, except above timberline, is broken by a forest-covered terrace or bench, and both descents are likewise steep, though less difficult than the opposite side. The canyon of Ash Creek is better timbered and a little less precipitous than that of Mud Creek. The canyons of Bolam and Whitney creeks, like that of the upper part of Mud Creek, are terrific naked chasms, very deep and so steep that in most places the loose material of their sides will not sustain the weight of a man—much less that of a horse—and when disturbed dashes in avalanches to the bottom.

Diller Canyon is peculiar (pl. II). It is a tremendous gash on the west side of the otherwise symmetrical cone of Shastina, which it cleaves from top to bottom before taking its practically straight westerly course down the rest of the mountain. It is the only canyon on Shastina, the only notable one on the west side of Shasta, and the only one anywhere on the mountain that does not emanate from a glacier. Its stream comes from enormous banks of perpetual snow.

While the upper parts of the canyons are exceedingly steep and barren, and practically devoid of vegetation, the middle and lower parts are invaded by the trees of the adjacent slopes, and in marshy and springy spots contain patches of willows, alders, and a multitude



THE HELIOTYPE PRINTING CO., BOSTON

SOUTHEAST SLOPE OF SHASTA, SHOWING CANYONS OF MUD AND CLEAR CREEKS.
(KINDNESS OF J. S. DILLER.)

of smaller plants. These places, in Mud Creek and Ash Creek canyons, are the homes of the mountain showt'l or sewellel (*Aplodontia major*), a curious bob-tailed rodent resembling a large muskrat, which lives in a labyrinth of subterranean passages in wet ground, and cuts and drags to its burrows bundles of coarse plants on which it feeds. Weasels (*Putorius arizonensis*) are usually found in the aplodontia colonies and it is safe to assume that their presence there is the most serious factor in the life of the rightful owners of the land.

STREAMS.

The streams that come from glaciers are rapid, turbid, and muddy, and have cut deep V-shaped canyons down the steep slopes of the mountain. Those that come from melting snow are clear as crystal and usually flow on the surface or in shallow channels hardly more than a foot or two in depth. They are smaller and less constant than those from the glaciers, and in times of high water carry so much gravel and pumice that they often block their own shallow channels and overflow, cutting new courses near the old ones. During the fluctuations incident to the irregular melting of snow they often reopen the older channels and at the same time retain the new, so that on the higher slopes it is not unusual for a mountain rivulet to occupy several beds at the same time. These are commonly separated by intervals of a few feet or a few rods, and the spaces between are often covered with patches of red heather, dotted with flowering plants of many kinds.

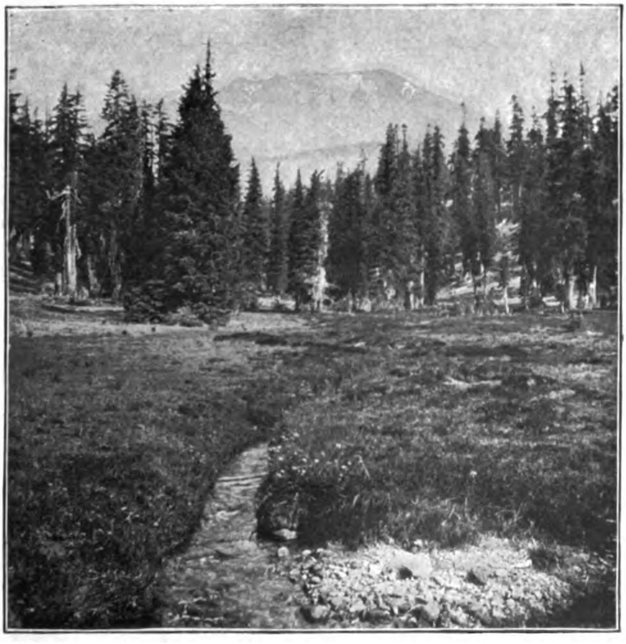


FIG. 10.—Heather meadow on upper Squaw Creek, showing concentration of vegetation near stream.

The banks of the more permanent streamlets are so well supplied with moisture that the heather and other plants, often mixed with alpine mosses,[1] form a sod which, growing thicker each year, gradually comes to overhang and finally bridge the swiftly running water. Even away from these sod bridges, which for long distances completely hide the water, the space between the constantly protruding banks is so narrow that only the middle part of the stream can be seen.

The icy rivulets abound in cascades, miniature waterfalls, and crystal pools, bordered by overhanging banks of moss, heather, and dwarf alpine laurel, and adorned by the waving heads of the scarlet painted cups and cream-colored parnassias. They are ideal homes for the water ouzel (*Cinclus mexicanus*), the large water shrew (*Neosorex navigator*), and the mountain vole (*Microtus mordax*). The latter animal is particularly abundant, and its dark burrows, almost hidden among the plants, may be found opening out on the vertical overhanging banks only a few inches above the water, so that whenever the occupants come out they may plunge in the icy stream before proceeding on their journey. Minks occur lower down along the streams, and still lower, otters.

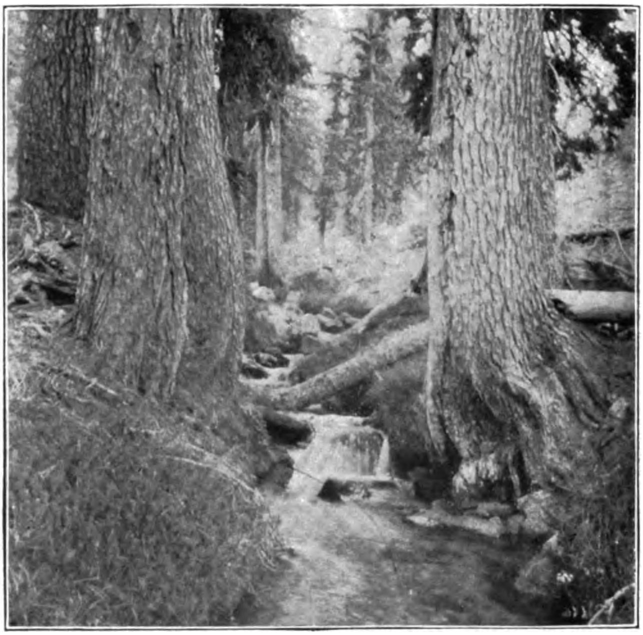


FIG. 11.—Miniature cascade on upper Squaw Creek, frequented by water shrews and ouzels.

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[1] The prevailing moss on the banks of the alpine streams is *Aulacomnium androgynum*.

ROCK SLOPES.

The whole upper part of the mountain between the glaciers and snow banks above and the forest belt below consists of bare rocky slopes, broken at intervals by precipitous cliffs and small heather meadows. The slopes are largely pumice sand, strewn and mixed with fragments of gray volcanic rock, among which the individual plants are so scattered as to disappear in the general view.[1] White-footed mice (*Peromyscus gambeli*) are common on these slopes, feeding on seeds of *Polygonum newberryi* and other timberline plants. Pocket gophers (*Thomomys monticola*) occur here and there and throw up their characteristic mounds in the pumice sand between the rocks. They subsist on the tough roots of alpine plants, and were observed at intervals up to an altitude of 9,000 feet. The pika or rock cony (*Ochotona schisticeps*) inhabits steep rock slides at distant points around the peak, and lays up stores of plants for winter use. Another mammal inhabiting the rock slides

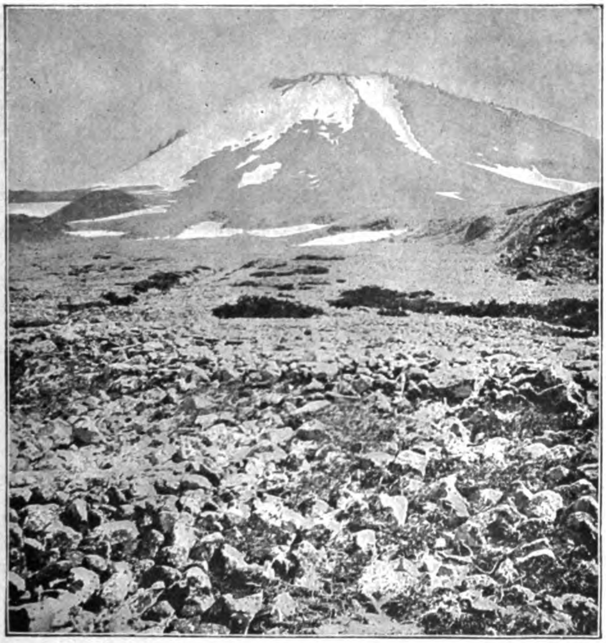

FIG. 12.—Characteristic rock slope on north side of Shastina.

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[1] The commonest plants of the bare stony pumice slopes are: *Agoseris monticola, Antennaria media, Arabis platysperma, Chænactis nevadensis, Chrysothamnus bloomeri, Cymopterus terebinthinus, Eriogonum polypodum, E. pyrolæfolium, Erigeron compositus trifidus, Hulsea larseni, H. nana, Lutkea pectinata, Lupinus* '*ornatus*,' *L. lyalli, Pentstemon menziesi, Phlox douglasi diffusa, Polygonum newberryi, P. shastense, Saxifraga tolmiei, Senecio canus, Silene grayi, S. suksdorfi, Spraguea umbellata, Streptanthus orbiculatus*, and *Viola purpurea*. Besides these, several ferns occur very sparingly on the rock slopes. These are *Dryopteris aculeata scopulina, Cystopteris fragilis, Cheilanthes gracillima*, and *Phegopteris alpestris*.

and cliffs, but for some unaccountable reason even rarer than the cony, is the bushy-tailed wood rat or pack rat (*Neotoma cinerea*), which, if my memory serves me correctly, is less common on Shasta than on any other mountain I have visited in the West. The mountain chipmunk (*Eutamias senex*) and golden ground squirrel (*Callospermophilus chrysodeirus*) inhabit the tongues of pines on the ridges, and not infrequently live in burrows among the bare rocks. Marmots, it is safe to assert, are altogether absent. We completely encircled the peak in the neighborhood of timberline, and examined innumerable ledges and rock slides, such as on other mountains are inhabited by marmots, but without finding so much as a track or sign or even a bleached bone to indicate that any member of the genus *Arctomys* had ever inhabited Shasta. In former days the bighorn (*Ovis canadensis*) was common here, but now the occasional fragment of a skull or the scattered parts of a skeleton are all that remain. In fall the old bucks of the Columbia black-tail deer wander up on the higher ridges. Here and there, particularly in the shelter of the prostrate white-bark pines, tracks and dung of rabbits were seen, but in spite of all our efforts no member of the party succeeded in finding a rabbit on the mountain. The species is probably the Sierra rabbit (*Lepus klamathensis*), though from the large size of some of the dung pellets I was inclined to suspect the presence of *Lepus campestris.*

AVALANCHES.

During the loosening of the snow in spring, avalanches must be very common on the higher slopes, and it is probable that they exert a controlling influence in determining the timber areas above the limit of continuous forest. Nothing forces itself on the observation more firmly than the peculiar way in which the white-bark pines are restricted to the long radiating ridges where they form narrow tongues, separated by broad intervals of steep slopes and basin-shaped valleys. While it might be hazardous to assume that the absence of trees from these extensive slopes and basins is due mainly to avalanches, the fact remains that the tracts they occupy along the tops and upper slopes of the ridges are entirely out of reach of these resistless engines of destruction.

Now and then, however, an avalanche, taking an unusual course, reaches the outskirts of one of these tongues of alpine pines and snatches up and carries below all that lie within its path. This is evident from the weathered trunks and roots often found at the bottoms of slopes where trees have never grown.

The most conspicuous path of a recent avalanche observed is on Cold Creek, between the deep canyons of Mud and Ash creeks (fig. 13). Here an avalanche of unusual size must have shot down the higher slopes until it reached the upper edge of the continuous forest of Shasta firs, where, instead of stopping, it cut a broad swath through the huge trees, tearing them up by the roots or snapping them off and carrying them on over an almost level tract with such resistless force that the few now left standing are deeply scarred at a height of 10 to 15 feet above the ground, showing where they were struck by other trees in passing over the deep snow. Hundreds of huge trunks 75 to 100 feet long and 3 or 4 feet in diameter are strewn in desolate confusion over the broad area that marks the place where this terrific avalanche slowed up and finally stopped. The accompanying illustration shows a part of this area, and also the gate cut by the avalanche when it struck the upper edge of the forest.

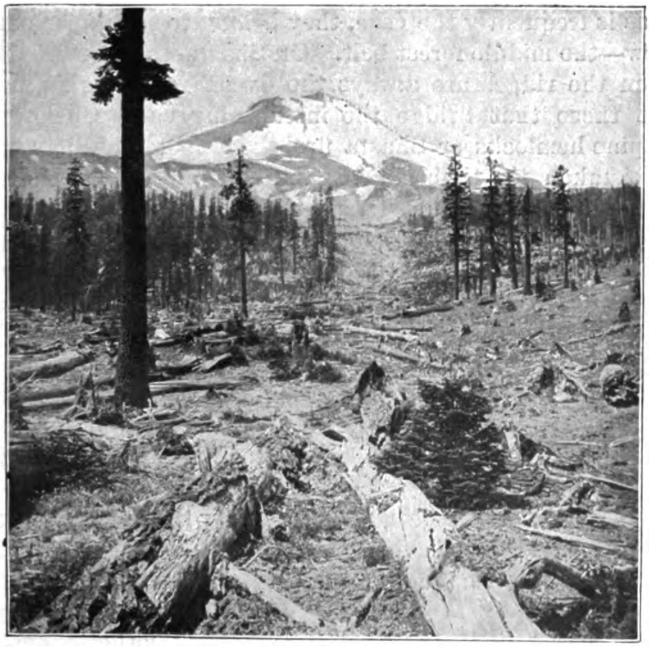


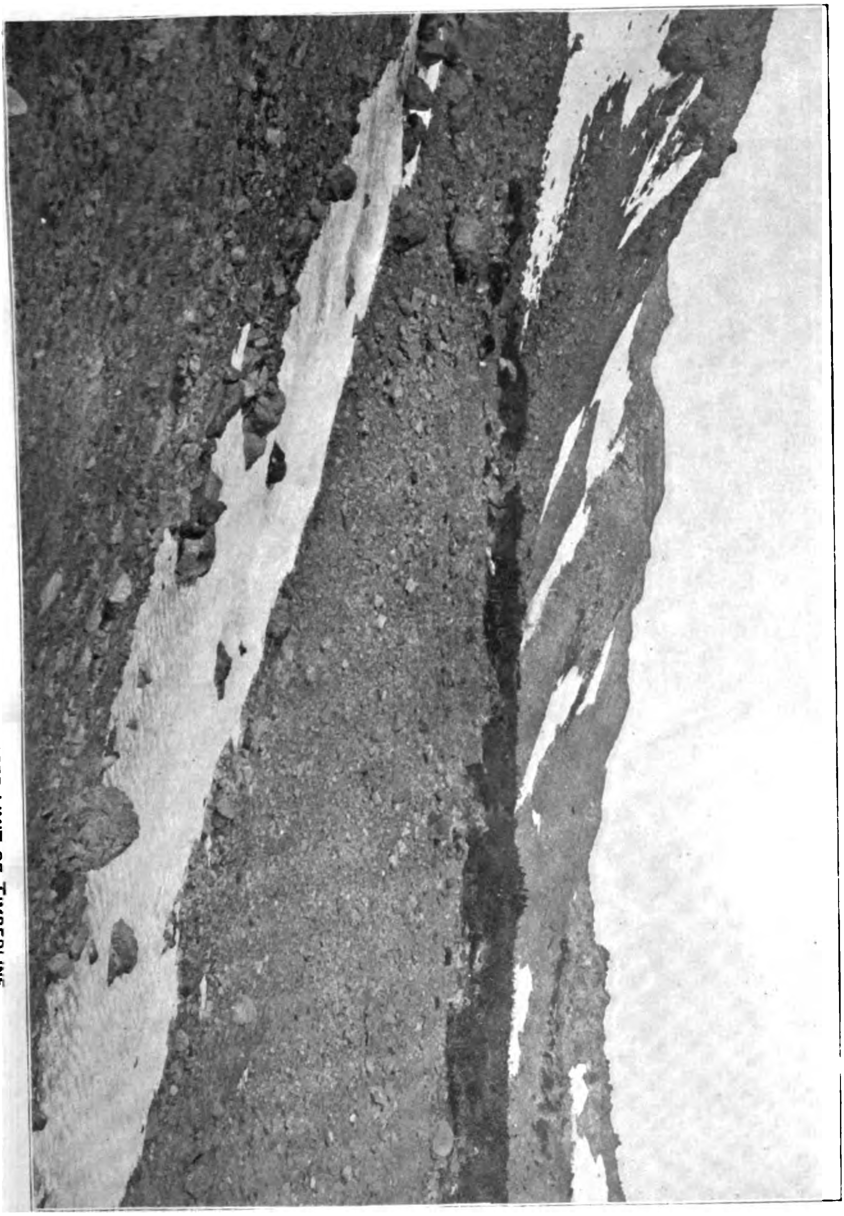
FIG. 13.—Track of avalanche invading forest of Shasta firs on Cold Creek, east side of Shasta.

TIMBERLINE.

Timberline is the upper or boreal limit of tree growth, as determined by temperature. It varies somewhat according to the particular species of tree, for even Hudsonian species differ in the degree of cold they are able to endure. Thus in the northern Cascades where the alpine hemlock and alpine fir are the dominant timberline trees, the fir pushes up to higher altitudes than the hemlock. So on Shasta, where the alpine fir is replaced by the white-bark pine, the latter is the true timberline tree and always attains higher elevations than the hemlock.

Theoretically, nothing is easier than tracing timberline on a mountain whose upper slopes are bare or dotted with alpine flowers and whose middle slopes support a continuous forest. Yet on Shasta, and on most high mountains, it is exceedingly difficult to fix the boundary of timberline or indicate its exact position on a map. Of course, it is possible to follow the uppermost trees wherever they may lead, but a map showing such a route would resemble a saw from which alternate teeth had been removed, the remaining teeth indicating the way the dwarf trees push up on the summits of ridges, the broad spaces between the teeth, the treeless gaps, usually the intervening valleys or basins. Trees always occur at some point in the bottoms of these valleys, and usually extend completely across them, but at an altitude a thousand feet or more lower than that reached on the ridges, and there is a material difference in the trees themselves. If of the same species, those in the valleys are much larger and taller; if of other species, as is frequently the case, they belong to the upper part of the belt below—the middle forest belt. On Shasta, the trees that push up highest on the ridges are always the dwarf white-bark pines, while as a rule those that bridge the intervening valleys below are full-grown alpine hemlocks or Shasta firs, the upper limit of which must not be mistaken for timberline. The difficulty lies in determining what ought to be considered true timberline, and the reason why in the absence of obvious barriers the white-bark pines do not fill more than a third or a fourth of the belt to which they properly belong. If a mountain could be found whose upper slopes form a true cone instead of a series of alternating ridges and valleys, so that successive transverse sections would be circular in outline, instead of irregularly scalloped, it is probable that timberline would form almost a true circle around the peak, rising a little on the southwest and dipping down a little on the northeast. But in the absence of such ideal conditions, actual visible timberline is usually confined to the borders of the tongues of dwarf trees that occupy the summits of the radiating ridges (pl. IV). The explanation of the absence of trees from the intervening valleys is not always easily found; still, if the valleys are studied with reference to the details of their several slope exposures and other local conditions, the position of the hypothetical timberline, in most cases, will be obvious. Let us take, for instance, one of the numerous glacial basins on the south side of Shasta, bordered on each side by lofty ridges which are capped by tongues of white-bark pines. The bottom of the valley, whenever its axial slope is steep enough to be regularly swept by avalanches, can not, of course, contain trees. The broad basin slope of the ridge on the west faces east and is in its own shadow in the afternoon; as a consequence it is too cold for trees, but is well sprinkled with alpine plants. Its summit is covered with dwarf white-bark pines, which come up from the other side and end abruptly along its eastern crest. The cold eastern slope is, in its zone position, actually above timberline, although the tongue of dwarf trees along its crest may stretch up a thousand feet above the lowest alpine plants.

On the opposite or eastern side of the basin the slope faces west or southwest, and receives the warm rays of the afternoon sun. The



Tongue of Dwarf White-bark Pines at extreme upper limit of Timberline.

(Kindness of J. S. Diller.)

result is that this slope, unless too steep or otherwise unsuited to tree growth, or within the track of avalanches, is commonly covered with white-bark pines. As a rule the timbered area on these westerly slopes takes the form of a broadening tongue, beginning at the highest altitude attained by trees on the crest of the ridge and increasing in width at lower altitudes until the bottom of the valley is reached and skirted, and the limit of avalanche movement passed, when the trees again strike out boldly. The pines in the basins are much larger and more erect than those on the summits of the ridges; they decrease in size with increase in elevation. The long oblique line which on the west side of each ridge marks the lower limit of tree growth commonly marks also the upper limit of the area in shadow during the late afternoon. In local spots other factors may account for the absence of trees. Thus, they are always absent from the avalanche-swept bottoms of the valleys, and from ground kept wet by springs or melting snow. Studied with these facts in view, comparatively few treeless areas will be found which can not be explained, and the position of true timberline may be fixed with some degree of certainty. This is really a very important matter inasmuch as it affects the zone position of a great many species.

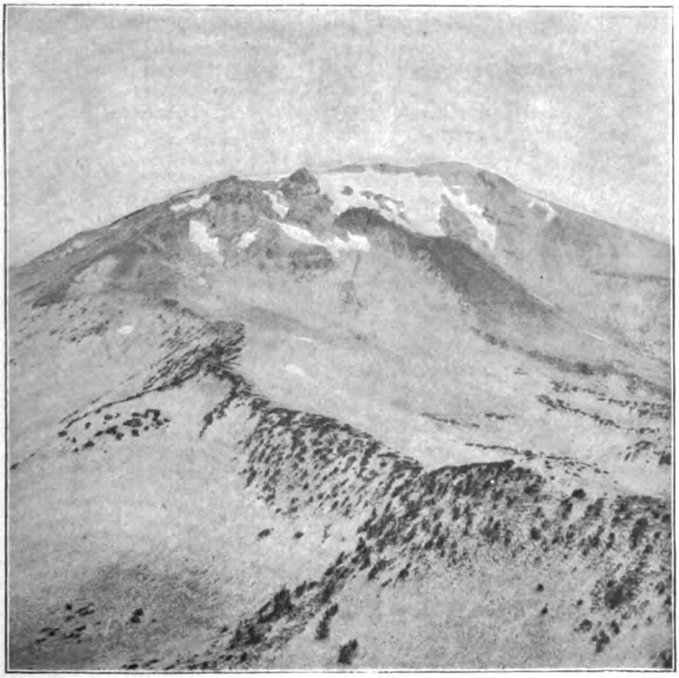


FIG. 14.—High timberline ridge, showing effects of slope exposure. The dark patches on the left (west) side of the ridge are dwarf white-bark pines. (Photographed by John H. Sage.)

It is necessary to remember that the reason trees are absent from the cold east and northeast slopes of the ridges whose summits are covered with dwarf trees is that these slopes are in their zone position truly alpine and above timberline, as already explained.

Nothing is easier than to refer to the wrong zone species found in the treeless basins between the pine-covered ridges. But when it is understood that parts of each basin, regardless of the distance below the highest tongue of timber, are unquestionably *above* timberline (and consequently *Alpine*) and that other parts, regardless of the distance above the nearest trees in the basin, are unquestionably well *below* timberline (and consequently *Hudsonian*), mistakes of this kind will be less frequent.

THE FORESTS OF SHASTA.

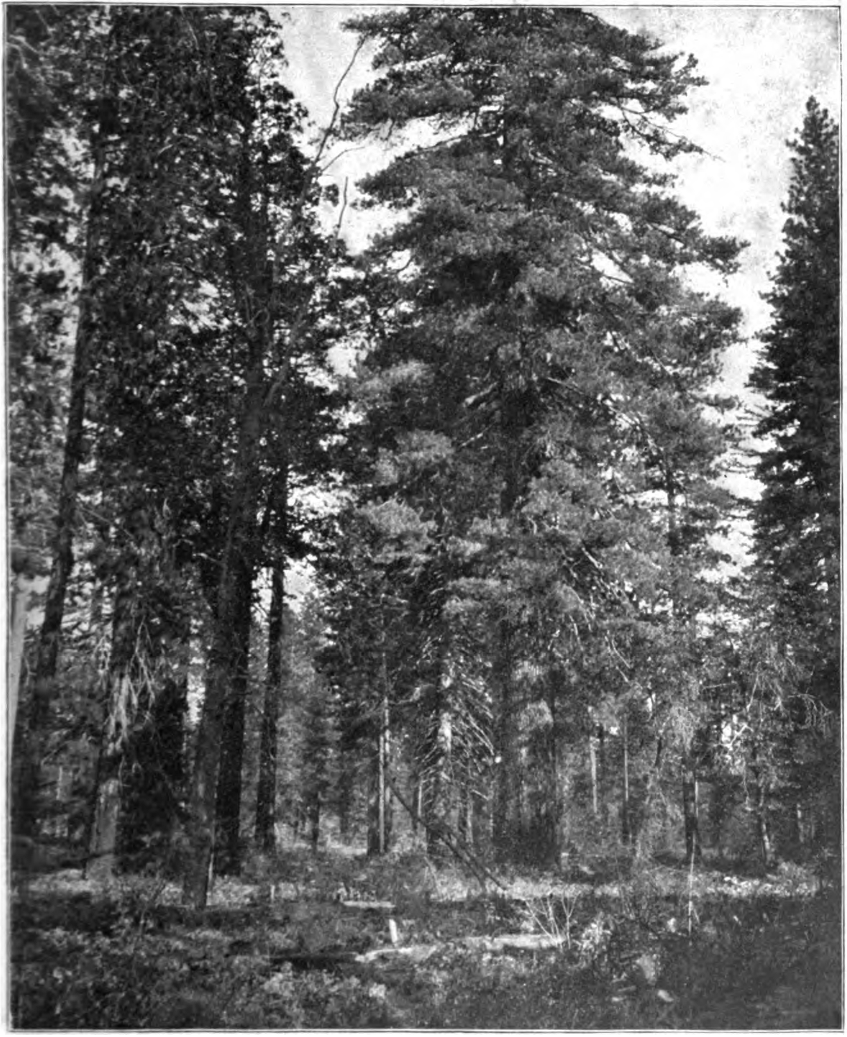
Shasta rises from a forested region (pl. V), and the mountain itself is continuously forest-covered up to an altitude of 7,500 or 8,000 feet. The trees of the lower slopes are those of the surrounding region, but those of the middle and upper slopes belong to such widely different species that it is necessary to divide the mountain forest into three belts, which, from their most distinctive trees, may be designated (1) the lower or yellow-pine belt; (2) the middle or Shasta fir belt, and (3) the upper or white-bark pine belt. It is interesting to observe that these forest divisions, as shown later, coincide with the three Life zones—the Transition, Canadian, and Hudsonian.

(1) The Lower Belt or Belt of Yellow or Ponderosa Pines (*Pinus ponderosa*).

The most abundant and characteristic tree of the lower slopes and surrounding region is the yellow or ponderosa pine, which forms a continuous open forest up to an altitude, on the south and west sides, of about 5,500 feet. The only material gap in the pine belt of the mountain proper is a strip about 8 miles in length on the cold northeast quadrant, which is occupied by lodge-pole pines belonging to the zone above (Canadian zone).

On the south and west the open pine forest of the basal slopes is interrupted by extensive parks, which from a distance appear to be meadows of waving grass. A nearer view shows this to be an illusion, the broad fields of green being in reality impenetrable thickets of chaparral—a chaparral of unyielding manzanita and buck brush (*Arctostaphylos patula* and *Ceanothus velutinus*, see fig. 15).

Northwest of Shasta the yellow-pine forest is interrupted by the open plain of Shasta Valley, which on the southwest ends abruptly at the town of Edgewood. North, northeast, and east of Shasta the ponderosa pine forest continues with unimportant interruptions to Devils Garden, Goose Lake, and the Madeline Plains; on the south it is practically continuous to the base of Lassen Butte, and thence along the flanks of the Sierra for 350 miles; on the southwest it follows the canyon of the Sacramento River to a little below Delta, where, in the bottom of the canyon and on its warmer slopes, the curious digger pines of the Upper Sonoran zone mix with and soon replace the ponderosa pines



PINE FOREST AT WEST BASE OF SHASTA

Showing yellow and sugar pines.

of the Transition zone. On the cooler and higher canyon slopes and adjacent foothills the ponderosa pines continue to the border of the Sacramento Valley. West of Shasta they cover all but the highest elevations of the Scott Mountains, completely surround Scott Valley, and reach up a considerable distance over the east arm of the Salmon Mountains, where, mixed as usual with Douglas firs, incense cedars, and sugar pines, they fill the Transition zone. Still farther west they occur in greater or less abundance in the valleys of Russian Creek, North and South forks of Salmon River, Trinity River, and Klamath River, and at appropriate altitudes on the west arm of Salmon Mountains, Trinity Mountains, and the mountains between Hoopa Valley and Redwood Creek. Hence the Shasta forest of ponderosa pines is directly continuous—either broadly or by narrow and tortuous tongues—with corresponding forests of southern Oregon, northeastern California, northwestern California, and the flanks of the Sierra.

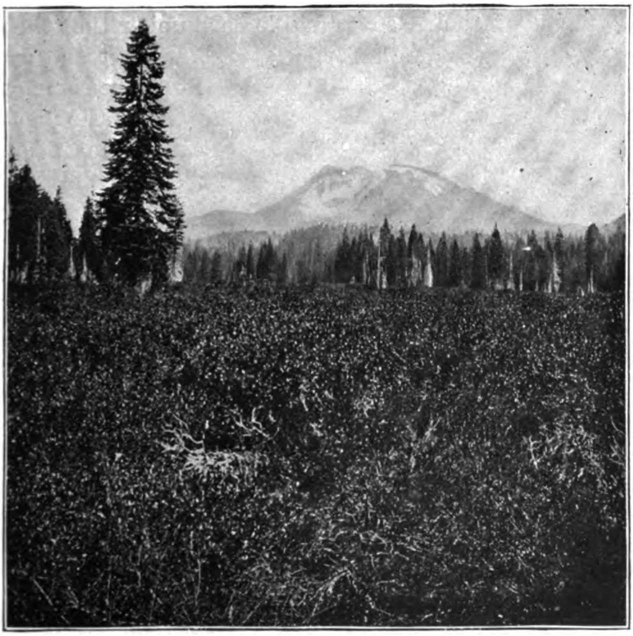


FIG. 15.—Manzanita chaparral on south slope of Shasta.

The ponderosa pines of the Shasta plateau and adjacent region are peculiar—peculiar in the extent of their variability—and deserve careful study. Not only do the cones of adjacent trees present an unusual degree of variation in size and compactness (particularly noticeable in Scott Valley), but the cones of trees subjected to apparently slight differences of temperature, moisture, and soil present certain average differences that are quite surprising. Moreover, on higher parts of the Scott Mountains, and also along their cool east base, fairly typical *Pinus jeffreyi* grows within a short distance of *ponderosa*. Whether or not the two actually intergrade, while an interesting question, is of little consequence compared with the fact that here, as in the Sierra, the two trees occupy adjoining but distinct belts—*ponderosa* the warmer and normally the lower; *jeffreyi* the colder and normally the higher. It sometimes happens, however, as in places along the cold east base of the Scott Mountains, where local conditions produce abnormal temperatures, that a strip of Jeffrey pine is sandwiched in between two areas of ponderosa pine. In this instance the low temperature comes in part from the cooling effects of cold streams, and in part from the afternoon shadows of the mountains.

The ponderosa forest is nowhere pure over any large area, but is sprinkled in varying proportion with sugar pines, incense cedars, Douglas firs, and white firs, and at lower altitudes with black oaks. The stately sugar pines are so valuable for lumber that the best have been already cut, but enough remain to show that the species was formerly common in most parts of the ponderosa forest. The incense cedars also are scattered over the whole region, but the Douglas and white firs require more moisture and consequently are less evenly distributed. They are most abundant on the borders of streams, in cool canyons, and along the well-watered east base of Mount Eddy and the Scott Mountains, where they become the dominant trees, the ponderosa pines being comparatively scarce. On drier and warmer soil, away from the cooling influence of the Scott Mountains, the ponderosa pines rapidly increase, and in the area between Black Butte, Shasta Valley, and the mountain, although sprinkled with incense cedars and black oaks, they form the purest ponderosa forest of the region.

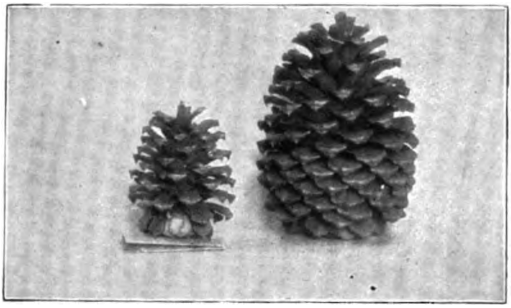


FIG. 16.—Cones of ponderosa and Jeffrey pines.

Another conifer of the yellow-pine belt is the knobcone pine (*Pinus attenuata*), a narrow interrupted tongue of which pushes up Panther Creek. The deciduous trees of this belt are the black oak (*Quercus californica*), Oregon maple (*Acer macrophyllum*), tree alder (*Alnus tenuifolia*), and Oregon dogwood (*Cornus nuttalli*). The maple and dogwood are restricted to the lowest levels and do not occur in very dry places; the alders are confined to the neighborhood of water; the oak ranges more widely over the lower half of the pine belt and thrives on dry as well as on moderately moist soils.

The conifers will be considered as individual species.

SUGAR PINE (*Pinus lambertiana*).—The sugar pine is the largest, handsomest, and noblest of our western pines, and its wood is so valuable for lumber that, except in inaccessible places, the best trees have been cut. The huge trunks, often 6 or 7 feet in diameter, rise as straight symmetrical pillars to a height of 150 or 200 feet, and are covered with fine beautiful bark. The long and graceful branches are usually confined to the upper parts of the trees, and the cones they carry are the longest known, frequently attaining a length of a foot and a half and sometimes of 2 feet. They are very light, however, and when falling are by no means so dangerous to the passer below as the shorter and more massive cones of the digger pines.

Around the base of Shasta the sugar pines reach from a point on the northwest slope about 4½ miles southeast of Edgewood, near the south end of Shasta Valley, southerly and westerly all the way around to Ash Creek, where they cease at an altitude of about 5,000 feet. They are fairly common in McCloud Valley and at Sisson, whence they extend south along the Sacramento Canyon to 'The Loop.' They are at present more abundant in the neighborhood of Black Butte than elsewhere about the mountain. In the Shasta region they are not so large as on the west slope of the Sierra in central California; still the stump of a sugar pine measured by me in McCloud Valley was 7 feet 7 inches in diameter 6 feet above the ground.

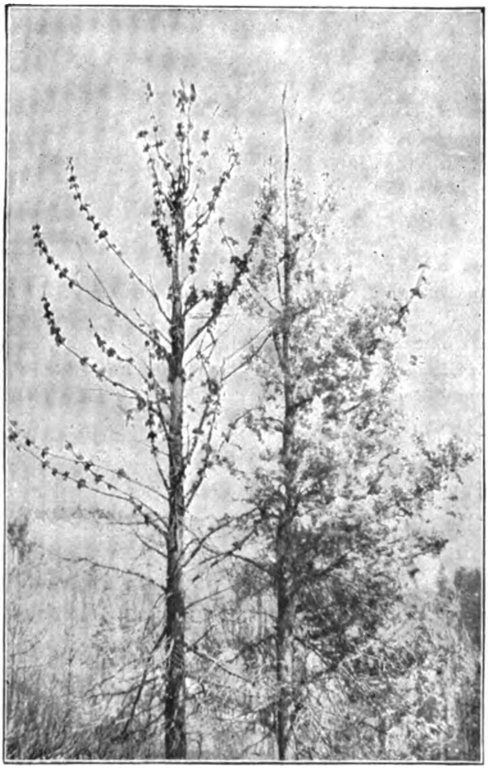


Fig. 17.—Knobcone pine on Panther Creek.

Knobcone Pine (*Pinus attenuata*, fig. 17).—The knobcone pine is a tree of erratic distribution. On Shasta it is confined to the lower slopes on the south side, from Panther Creek easterly to a point between the branches of Mud Creek, where it ranges irregularly from an altitude of 3,800 up to 5,600 feet. The latter limit is attained in a gully a little east of Wagon Camp, in a continuation of the Panther Creek strip. Lower down on Panther Creek, where the original forest of ponderosa and sugar pines has been removed by the combined work of lumbermen and forest fires, and the slopes are now covered by an impenetrable jungle of manzanita, this singular pine remains, commonly growing in narrow lines. The trees are rarely more than 50 feet in height, and most of them are much smaller. They bear a marvelous load of slender curved cones, which on the limbs grow close together in whorls or rows, and on the trunks are scattered or grow in circles. They remain on the trees for many years, as in the case of few other species, and their large size, extraordinary numbers, and peculiar arrangement give the tree a singular and unusual appearance.

Vernon Bailey has given me the following note on some knobcone pines examined by him on Panther Creek, September 27, 1898:

> The trees were loaded with cones, in whorls of three to seven around the branches, and down the trunks to 10 or 12 feet from the ground. Some of the cones must have been 20 or 30 years old, and perhaps much older. I cut off a lot of the old lower cones to see if the seeds were good, and put them on a bowlder and cracked them with a few hard blows of the ax. All of them were full of worm dust, with only now and then an undiscovered seed or a fat white worm. Cones of medium age (5 or 6 years back from the end of the branch) were invariably occupied by worms and worm dust, and usually contained few good seeds. Cones only 1 or 2 years old were rarely wormy. A great many of the old cones had been dug into by woodpeckers, either for seeds or, more likely, for the fat white grubs that live on the seeds. The cones are too hard to be broken or split apart by the woodpeckers, and are opened by a smooth hole drilled into the middle, or sometimes to the opposite wall. Usually the opening is long and narrow. Sometimes the whole inside of the cone has been drilled out, leaving only the shell; sometimes a small round hole has been drilled just through the outer shell.

WHITE FIR (*Abies concolor lowiana.*)—The white fir ranges from Sisson, at the bottom of the west slope of Shasta, up to the lower edge of the Shasta fir belt, which it slightly overlaps. At Wagon Camp (fig. 1, alt. 5,700 feet) both species are common. The white fir requires more moisture than the other conifers of the lower timber belt, and consequently its distribution is discontinuous. It is most abundant along the well-watered eastern base of Mount Eddy, north of Sisson. The highest elevation at which it was observed is a warm ridge on the east side of Mud Creek Canyon, between the mouths of Mud and Clear creeks, where, with a number of other Transition zone species, it occurs at an altitude of 6,700 to 7,000 feet. This is 1,000 feet above its usual limit, and its presence here is due to the angle and steepness of the slope, as explained elsewhere (p. 49).

Abies lowiana is easily distinguished from *A. shastensis* and *A. magnifica* by the bark, which is very thick and deeply furrowed, so that it resembles that of Douglas spruce (*Pseudotsuga mucronata*) much more closely than that of the other *Abies* of the region. The cone scales are broad and rather short, and the bract is short and tricuspidate (fig. 19).

DOUGLAS FIR OR SPRUCE (*Pseudotsuga mucronata*).—Douglas fir is scattered irregularly through the ponderosa pine forest. Like the white fir, it prefers a moister soil than suits the ponderosa pines, and therefore thrives best in the gulches and near the streams. Thus along the cool well-watered east base of Scott Mountains the forest consists mainly of Douglas and white firs, with scattered incense cedars and sugar and ponderosa pines, while on the drier ground a little farther east the pines increase and the firs decrease or disappear. Most of the larger trees on the south and west slopes have been cut for lumber. A stump near McCloud Sawmill measures, at 6 feet above the ground, 8 feet in diameter.

INCENSE CEDAR (*Libocedrus decurrens*).—The incense cedar occurs in greater or less abundance in all parts of the ponderosa forest, on both dry and wet ground, and from the bottom of the valley at Sisson up to the edge of the Shasta firs at Wagon Camp. But it is commonest near the cool east base of the Scott Mountains. In moist places the trees often grow in groups, but in the dry forest they are usually scattered at intervals among the pines. On Shasta the bark of the cedars is generally smooth and free from scales, except on the very youngest trees. In the more humid area between Scott Mountains and the coast the scaly bark persists for many years, so that the trunks of middle-aged trees look very different from those of corresponding size in the dry interior.

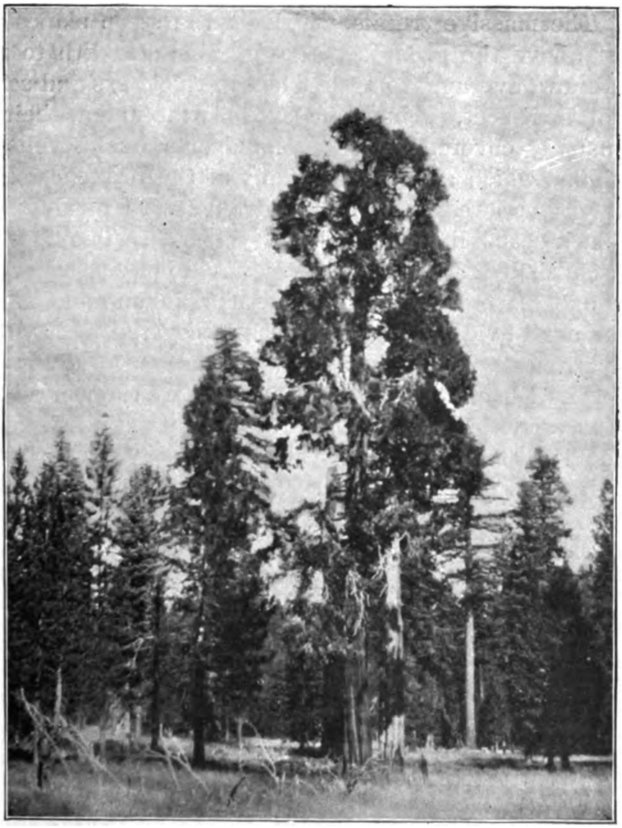


FIG. 18.—Incense cedar on south slope below Wagon Camp.

(2) The Middle Belt or Belt of Shasta Firs (*Abies shastensis*).

Above the forest of ponderosa pines, and therefore not connected with similar forests elsewhere, a belt of Shasta firs averaging 2 or 3 miles in breadth and 2,000 feet in vertical range completely encircles the mountain. It is the distinctive forest of Shasta—a forest of tall stately trees, dark, somber, and free from underbrush, though here and there beds of the low mountain manzanita (*Arctostaphylos nevadensis*) afford a pleasing relief from the uniform dark brown of the surface carpet—usually a shallow layer of fir needles mixed with decayed cones and wood. The massive trunks, which on the steep slopes are often swollen just above the ground to give greater strength to resist the pressure of snow, average from 4 to 6 feet in thickness and some attain a diameter of 7 or 8 feet. Above the level of winter snow their northern sides are usually covered with the handsome bushy yellow lichen, *Evernia vulpina*, which also clothes many of the branches; and in the denser parts of the forest the trees are draped with pendant masses of the long black-beard lichen, *Alectoria fremonti*. The forest almost everywhere consists of large mature trees, and is free from evidences of fire; but in one place, between Mud Creek Canyon and Cold Creek, a considerable area, evidently an old burn, is covered with young trees averaging perhaps 20 feet in height.

As a rule, the Shasta firs stop abruptly where the white-bark pines begin, and trees at their upper normal limit are of full size. But now and then on the steep and relatively warm southwesterly slopes of the ridges, dwarf Shasta firs occur. The highest point at which such were observed was at an altitude of 8,900 feet on the east rim of Mud Creek Canyon, where a few stunted trees 3 or 4 feet in height were found mixed with white-bark pines. On a similar warm slope west of Squaw Creek a scattered line of these trees was noted at an altitude of 8,100 to 8,300 feet. Here the largest were 20 feet in height. Their bark differed materially from that of trees lower down, being pale grayish instead of dark brown, and thin, smooth, and full of blisters, instead of thick and deeply furrowed. These fir trees were mistaken for another species until I had the good fortune to find a few bearing cones, which, on August 1, were two-thirds or three-fourths grown. To my surprise, they had long exserted bracts which, as in the young cones, stood straight out horizontally. Very young cones (2 to 3½ inches long) always appear to consist of bracts alone, the scales being hidden inside. On breaking open the cones the tiny scales are seen encircling the axis; they are less than half the size of the bracts and occupy the inner half of the diameter or section of the cone.

The normal bark of the Shasta fir resembles that of the alpine hemlock. It is rather regularly furrowed vertically, and the plates between the furrows are cracked horizontally, so that it suggests that of the ponderosa pine, though the plates are smaller and less red. Along the lower edge of the Shasta fir belt the bark is darker and the cracks and furrows are narrower.

The upper edge of the Shasta fir belt meets the alpine hemlocks and white-bark pines of the belt above; the lower edge the ponderosa pines, incense cedars, Douglas spruce, and white firs of the belt below. The firs are easily distinguished by bark, branches, and cones. The Shasta fir has very dark and relatively thin bark, regularly furrowed so as to form 'plates' like those of the ponderosa pines, only smaller, narrower, and transversely cracked. The branches are irregular, droop at first (from the weight of winter snow), and then curve upward, and the branchlets are small and terete, and stand out with mathematical precision; the cones are huge, and their green, tongue-like, single-pointed bracts protrude far beyond the scales, as in the noble fir of the northern Cascades. In young cones the bracts stand out straight; in old cones they are strongly deflexed. The white fir (*Abies lowiana*) has much thicker and grayer bark, deeply furrowed at base and not forming regular scales or plates; the branches are more regular and more nearly horizontal, the branchlets flatter, more spreading, and lacking the mathematical lines of the Shasta fir; the cones are more slender, and the tricuspidate bracts are short, reaching less than half-way across the scale. The cone-scale differences are shown in the accompanying diagrams. (See fig. 19.) The year 1898 was an 'off year' for cones, but plenty of old scales were found on the ground, and broken cones were discovered in holes in logs, where they had been carried by pine squirrels.

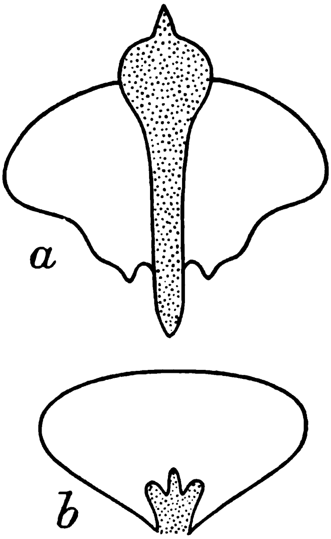


FIG. 19.—Cone scales of (*a*) *Abies shastensis* and (*b*) *Abies concolor lowiana*.

The Shasta fir forest is mainly pure, but in places, particularly on the east and northeast sides of the mountain, silver pines are scattered through it, and in one place along its lower border (between Ash and Inconstance creeks) the firs are replaced by lodge-pole pines, the only ones on the mountain.

Whether or not *Abies magnifica* occurs on Shasta is a question on which we can throw no light. I do not know how to tell *magnifica* from *shastensis* except by the cones, and the trees did not bear cones the year of our visit.[1] Still, we found great numbers of old cones tucked away by the squirrels in decayed logs, and disconnected scales under most of the trees where search was made, and among all these failed to find a single bract which was not strongly exserted. And yet Miss

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[1] While this paper was passing through the press (July, 1899), Walter K. Fisher revisited Shasta. He found the firs heavily laden with cones, and although thousands of trees were examined he failed to find a single cone without the exserted bracts.

Alice Eastwood showed me, in the herbarium of the California Academy of Sciences, a cone, said to have come from Wagon Camp, in which the bracts, except a few at the base, are not exserted.

SILVER PINE OR MOUNTAIN WHITE PINE (*Pinus monticola*).—Silver pines occur here and there on Shasta, scattered among the Shasta firs. They were found in greatest abundance on a pumice slope south of Brewer Creek Canyon, where they are the dominant trees up to an altitude of 7,200 feet, and where the ground was strewn with cones of the previous year—cones in which the scales are strongly reflexed. In this area, along Brewer Creek, they meet and slightly overlap the alpine hemlocks and white-bark pines of the zone above. They are common also on the steep lava ridges on the north side of Shasta, particularly in the neighborhood of Inconstance Creek and in Mud Creek Canyon, especially on the west side of the ridge between Mud and Clear creeks. A few trees occur near the top of Red Cone, east of Wagon Camp.

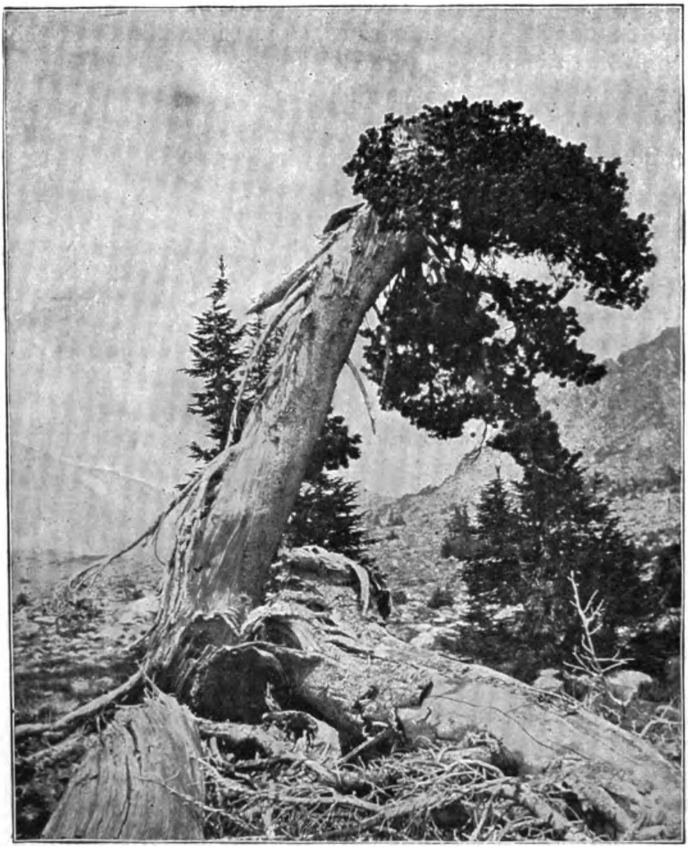

FIG. 20.—White-bark pine (*Pinus albicaulis*).

LODGE-POLE PINE (*Pinus murrayana*).—The lodge-pole pine was not found on Shasta except on the northeast quadrant, where Vernon Bailey, in following the wagon road around the mountain, passed through a belt of it about 8 miles in length. It begins 3 miles northeast of Ash Creek at an altitude of about 5,400 feet and reaches northerly to about 3 miles northwest of Inconstance Creek, where it ends abruptly at an altitude of 5,600 feet. Here it is the dominant tree, and in half of it the only tree. This area is covered during the latter part of the afternoon by the shadow of the mountain, and consequently is colder than places of equal altitude farther north or south. The soil is sandy and barren and the trees are of small size.

(3) The Upper Belt or Belt of White-Bark Pines (*Pinus albicaulis*).

Still above the forest of Shasta firs, braving its way upward over the bare rocky ridges into the very teeth of the domain of perpetual snow, is another timber belt—an open belt of straggling, irregular trees, whose whitened, twisted trunks with their storm-beaten heads of green are among the most weirdly picturesque objects on the mountain (fig. 20). The tree is the timberline white-bark pine, which, wherever found, pushes its way over steep and barren slopes to the extreme upper limit of tree growth.

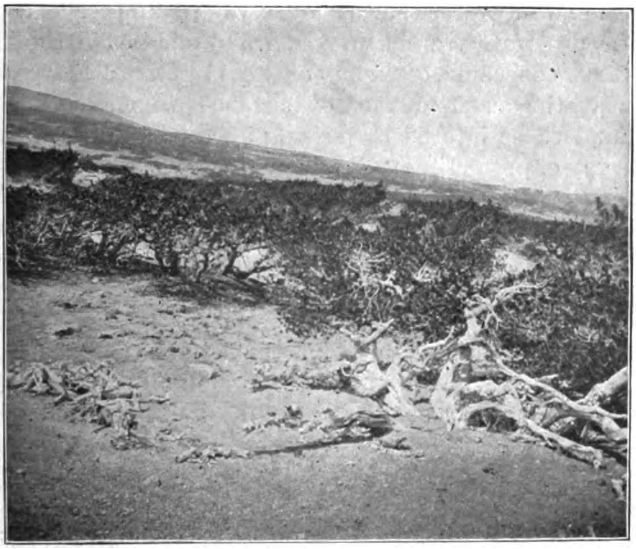

FIG. 21.—Dwarf white-bark pines on a high ridge.

At the lower part of its range it forms an almost continuous though narrow belt around the mountain, and often attains a height of 30 or 40 feet and a diameter of 2 feet. In the higher parts of its range it soon becomes restricted to the ridges, leaving the intervening basins and gulches bare, and as it climbs higher and higher becomes more and more reduced in size and undergoes material changes of form and position. At certain altitudes the slanting trunks, only 4 or 5 feet in height, serve as pillars to support the flattened tops which form a canopy of intertwined and matted branches (fig. 21).

These dwarf groves offer attractive shelters from wind and storm, and we usually camped among them when working the upper slopes.

The tree is one of exceptional hardihood, and as it pushes on still farther into the realm of cold the trunks become completely prostrate and the branches hug the ground, forming among the rocks dense mats which sometimes rise a foot or two above the general level, but at their upper limit usually occupy depressions, or, if growing in the lee of a bowlder, crouch behind it and continue its surface level to the adjacent slope, as if trimmed to fit. Indeed, one is amazed at the way these uppermost pines avoid exposure by flattening themselves into the hollows, as if afraid to lift a finger above the general level. Their life is a perpetual struggle—not against competing plants, but against a hostile environment. In summer they are buffeted by the winds and pelted by sand and gravel; in spring they are swept and torn by the resistless avalanches, and in winter they are deeply buried under heavy banks of snow. The prostrate trunks in young and middle-aged healthy trees are completely concealed, often half covered by stones and pumice sand, and hidden by the density of their own branches and foliage; but in very old trees, and those injured by passing avalanches or laid bare by the washing away of protecting rocks during violent storms, the trunks are partly exposed and their extraordinary features may be easily examined. As a rule they are not only naked, but the strongly twisted wood, gnarled, contorted, and, ironlike in firmness, has been eaten into by the sand blast till the knots and hardest parts stand out in prominent ridges.

A little below timberline on the north side of Shasta, between North Gate and Shastina, is an extensive gently sloping pumice plain, strewn with fragments of gray shaly lava, and thickly spotted with rather large mats of pines, averaging 2 to 4 feet in height, which give a most curious aspect to the region (fig. 22). This area, which is about a mile

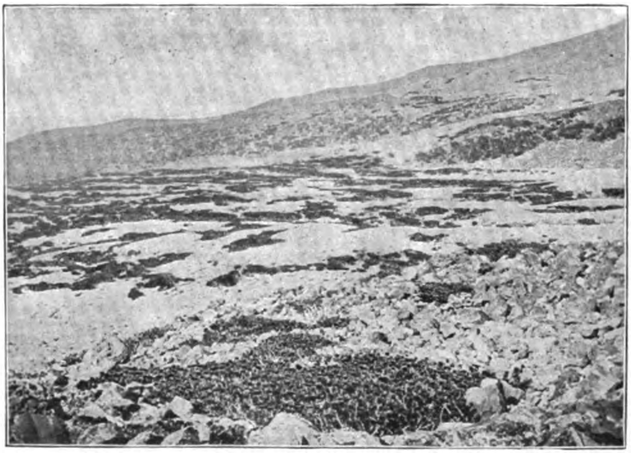

FIG. 22.—Pumice plain north side of Shasta, showing timberline mats of white-bark pines.

and a half across (horizontally), must contain thousands of acres of the dwarf, flattened pines. Along its lower edge, singularly enough, trees of the same species suddenly stand upright and grow to large size, forming a rather solid forest, perhaps 30 feet in height, with an abrupt front facing the dwarf pines above. The suddenness of the transition is unusual and difficult to explain.

The forest just mentioned is probably the largest continuous area of *Pinus albicaulis* on Shasta. Situated a little below timberline, it stretches, apparently without interruption, from North Gate Buttes to Diller Canyon, a distance of fully 5 miles, thus encircling the northwest quadrant of the mountain, including Shastina.

Perhaps the most attractive grove of white-bark pines on Shasta is one that fills an open gulch or glade on the east side of North Gate Buttes. Here, in the lower part of their belt, the trees are large and uncommonly symmetrical, and the gray pumice soil is covered with silvery lupines. In ascending the gulch the pines gradually decrease in size until at 'The Gate' (alt. 8,500 feet) they are dwarfed and their tops are broadly flattened.

The normal altitudinal limits of the white-bark pines on Shasta are hard to fix. On the south and southwest sides the trees descend in places to 7,500 feet and range thence upward on the hottest ridges to an extreme limit of 9,800 feet. But this extreme altitude is attained at two points only—on the long ridge above 'The [South] Gate' (near Red Butte) and on a ridge about a quarter of a mile west of Mud Creek Canyon. On the west rim of the canyon the pines stop at 9,500 feet and on the ridge on the east side at 8,600. Probably 9,300 to 9,500 would be a fair average for their upper limit on the warmer southerly slopes.

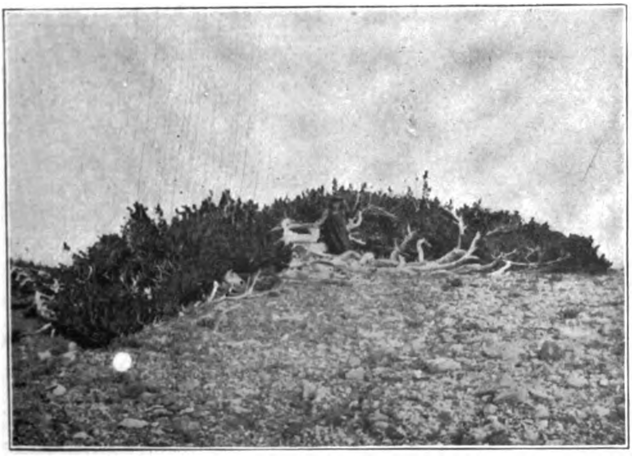

FIG. 23.—A large prostrate tree of white-bark pine, a little below timberline.

On the cold northeast slope, just south of Brewer Creek, they descend on a barren pumice slope to 7,000 feet, where, sparingly mixed with alpine hemlocks, they meet the upper limit of Shasta firs and silver pines.

BLACK ALPINE HEMLOCK (*Tsuga mertensiana*[1]).—But the white-bark pine, although the dominant and most widely distributed tree of the upper timber belt, is not the only tree, for in places it is mixed with or replaced by the black alpine hemlock. Shasta is a very dry mountain, and yet the white-bark pine thrives on its driest slopes and grows among the bare, naked blocks of lava where tree life seems impossible. The hemlock requires more moisture, and therefore is at a decided disadvantage. It never reaches as high as *Pinus albicaulis* and attains its best development along the lower border of the Hudsonian zone, where it occurs in disconnected sheltered localities—usually in canyons or on the shady east or northeast sides of buttes or ridges, where there is more moisture than on the exposed slopes. Since these shady easterly slopes are always cold, the hemlocks that occupy

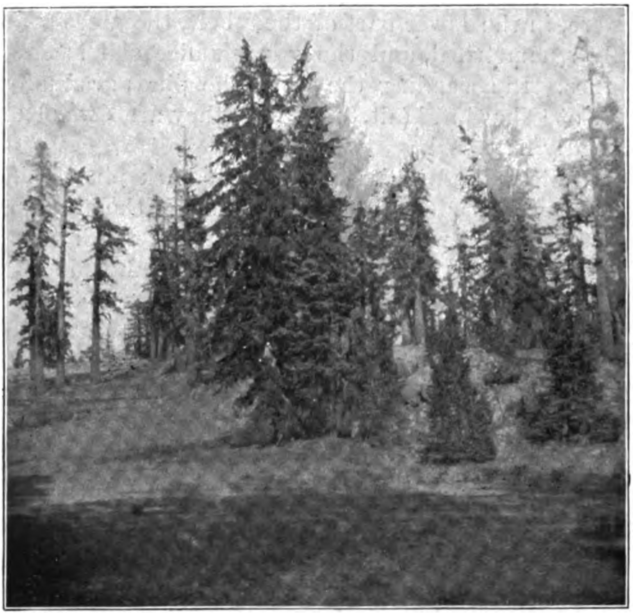

FIG. 24.—Black alpine hemlocks near Squaw Creek.

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[1] This is the species heretofore commonly known as *Tsuga pattoni* or *Tsuga pattoniana.* It has been recently discovered that the name *Tsuga mertensiana*, commonly applied to the Pacific lowland hemlock, was first given to the present alpine species, necessitating a most unhappy change of name. Fortunately, however, the common English names of the two and their widely different zone ranges—one restricted to the low Transition belt near the coast, the other to the high Hudsonian zone on the loftiest mountains—may prevent the confusion that otherwise would result from the change of name.

them descend in tongues considerably below the usual lower limit of the belt to which they belong. The most extreme case of the kind observed is on the east side of the series of hills and ridges known on the map as 'Gray Butte,' where a gulch, sheltered from the warm afternoon sun and moistened by seepage from melting snows, carries the hemlocks to a lower altitude than they reach elsewhere. On suitable slopes they usually begin about 7,200 or 7,300 feet and range up to about 8,000 feet. The highest altitude at which they were observed is 8,700 feet, a little east of Mud Creek Canyon, where a few stunted trees were found among the white-bark pines. Their extreme upper limit is thus a thousand feet lower than that of the white-bark pines. This is due, in part at least, to the character of the upper slopes, where no trees can grow except on the ridges—as explained under the head of Timberline (pp. 27–30)—and here the ridges are too exposed and too dry for hemlocks.

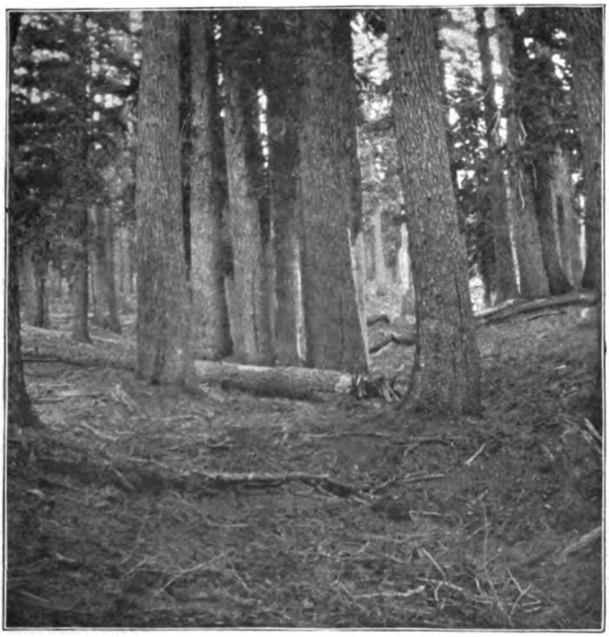

FIG. 25.—Group of alpine hemlocks near Deer Canyon.

On Shasta the alpine hemlock does not grow in such luxuriance or attain such dimensions as in the Cascade Range. The average height of mature trees seems to be 80 or 100 feet; the average diameter a little less than 3 feet. Trunks 4 and 5 feet through are by no means rare and the one shown in the accompanying photograph (fig. 26) measured 6 feet. It is a characteristic habit of hemlocks on sloping ground to grow in clusters, 3 to 7 springing from a common base. In this way, when young, they are better able to withstand the pressure of the snow.

Those that grow singly usually support themselves by having the trunks strongly curved downward just above the ground, as shown in fig. 26.

The alpine hemlock is one of the most picturesque and attractive trees of our western mountains. Its beauty is due in part to the handsome trunks and irregular drooping branches, but mainly to the dense and peculiarly tufted foliage which falls in graceful masses in such manner as to conceal the branches and upper parts of the trunks. The twigs or ultimate branchlets curve upward and the needles stand out on all sides and point outward—away from the body of the tree—producing a tufted appearance very unlike that of other conifers. This effect is heightened during the latter part of summer by the light green tips of the new growth.

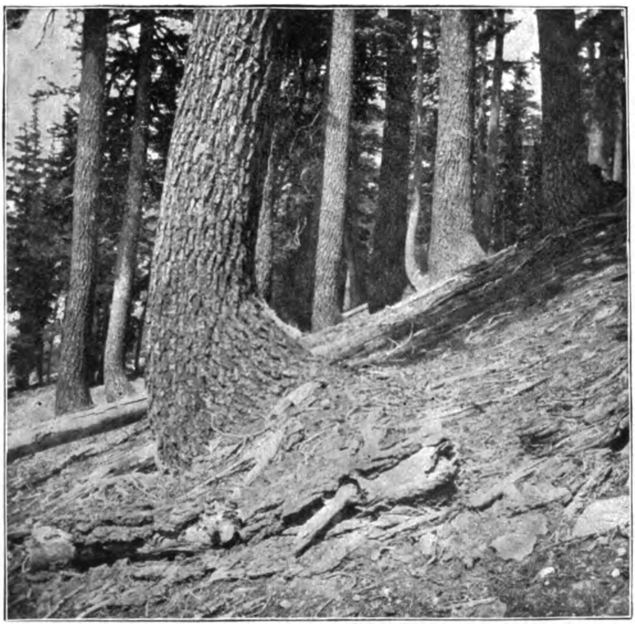

FIG. 26.—Trunk of alpine hemlock, showing thickening and curvature of base.

The hemlock forest is dark, somber, and silent, and its drooping branches are draped with the dangling beards of the black-beard lichen (*Alectoria fremonti*). The only color that breaks the otherwise uniform darkness is the bright yellow lichen (*Evernia vulpina*) which covers the north or northwest sides of the trunks and upper sides of the branches—a conspicuous feature and one seemingly out of harmony with the general tone of the forest. In all these respects the hemlock forest accentuates the features of the Shasta fir forest of the belt below, with which it is directly continuous. The tree trunks and bark also resemble those of the Shasta firs. The bark is in long scales which, as the trees grow, thicken into irregular plates transversely broken at intervals of 8 to 12 inches.

In the growing tree the branches die from below upward in a curious way. First a subdivision of a low branch dies and the tips curl downward and inward, drawing together until they form a close curl or tail which can be set on fire by a single match. Dozens of these curls can be seen on most of the young trees, and also on the lowermost remaining branches of the middle-sized and some of the old ones. This process of dying and curling continues until all the lower branches are dead. Meanwhile, the curl-tails gradually drop off and litter the ground, leaving the bare dead branches hanging down at a sharp angle. These dead branches hug the trunks closer than the living ones and cling on until the bark comes off, when they form an armature of unsightly bleached and brittle sticks pointing downward around the trunk. These in time break off, too, so that as the tree grows into maturity the handsome trunk finally becomes clear and clean.

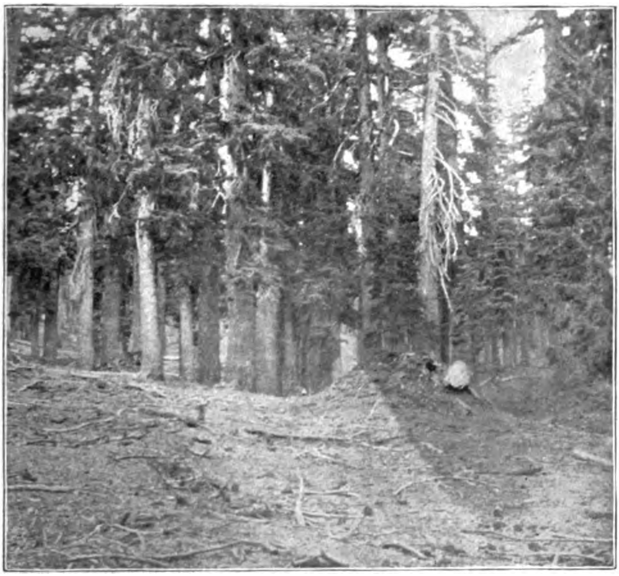

FIG. 27.—Group of alpine hemlocks.

The alpine hemlocks are prolific bearers and the ground is always strewn with their cast-off cones, which average about 2½ inches in length, and have a dark streak down the middle of each scale. When young the cones are conical, when old and the scales become fully reflexed they are slender, subcylindrical and only three-fourths of an inch in diameter. Year after year the cones fall to the ground in such prodigious numbers that they form a very important part in the layer of felting that covers the surface in the hemlock forests—a loose dark felting composed of disintegrating needles, twigs, and cone scales pressed firmly together by the weight of the snow in winter, and only rarely dotted by living plants. In moist spots, particularly along the borders of the tiny sparkling streams, the red heather (*Phyllodoce empetriformis*) forms little beds and the delicate feathery *Lutkea pectinata* spreads a faint veil of green over the dark soil. In the drier parts of the forest hardly a plant is seen save now and then a solitary clump of prince's pine (*Chimaphila menziesi*) or painted wintergreen (*Pyrola picta*).

Late in September the hemlocks molt and the wind brings down showers of needles that falling on the tent at night sound like rain. Their color has now changed from green to golden brown and they sprinkle the black floor of the forest so thickly as to change its appearance.

FOREST FIRES.

During the past ten years the country about Shasta, particularly on the west and south, has been repeatedly devastated by forest fires. Here, as elsewhere, lumbermen and fires have destroyed the greater part of the timber on the lower slopes and adjacent plain, which are now covered by a dense chaparral of manzanita and buckbrush, dotted with scattered pines. Fortunately, the fires have not as yet spread upward far enough to do much damage to the Shasta firs of the middle timber belt. Whether the character of these trees and the freedom of the ground beneath from combustible material will prevent the spread of fire remains to be seen. Thus far the greatest harm has been done in the forests of ponderosa and sugar pines, where lumbering operations are being carried on with painful vigor.

While we were on the mountain, from the middle of July until the end of September, one or more fires, the result of vandalism or neglect, were raging continuously on the south and west slopes, and two of them did irreparable injury. One began near some woodcutters' shanties, 3 or 4 miles below Wagon Camp, on the road to Sisson; the other and more destructive originated in the area covered by the lumbering operations from McCloud Mill and pushed swiftly up the Panther Creek slope, consuming the greater part of the only area of *Pinus attenuata* on Shasta and burning great tongues into the handsome fir forest on both sides of Wagon Camp, which it closely and almost completely surrounded.

The fire that lasted longest in the summer of 1898 did the least harm. It consumed a worthless tract of manzanita chaparral between Black Butte and the mountain, and gave off a surprisingly enormous quantity of smoke, hiding the country to the west for a full month. During its continuance the entire mountain was often enveloped in smoke and when the wind was northwest, as it was a great deal of the time, showers of burned leaves fell daily at our camps. On August 2, when we were at work on the rocky slopes above the head of Squaw Creek at an altitude of 9,500 feet, charred leaves fell so abundantly that we caught many in our hands. Great clouds of smoke rolled up between us and the sun, which became deep red like the full moon and then disappeared. At 5 o'clock the smoke began to settle back, as it always did when the chill of the evening came on, and the sun reappeared, to set as usual behind the dark outlines of the distant mountains.

Fires on the south, in the valley of the McCloud, cut off the view in that direction, and it was only at rare intervals, and usually at sunset, that we were able to see the snowy crown of Lassen Butte 60 miles away. Even Castle Crags, almost at our feet, were rarely visible. This experience is frequent in the west; and of the hundreds of persons who visit the Pacific slope every summer to see the mountains, few see more than the immediate foreground and a haze of smoke which even the strongest glass is unable to penetrate.

Along the railroad between the head of Sacramento Canyon and Shasta Valley one traverses desolate tracts which a few years ago were covered by a noble forest of ponderosa and sugar pines.

EFFECTS OF BURNS IN CHANGING ZONE POSITIONS.

A burn in the lower part of the Shasta fir forest a little above Wagon Camp affords an excellent illustration of the way fires sometimes change the zone relations of particular areas. The area in question was well within the Canadian zone before the fire, which occurred only a few years ago. Since the fire, Transition zone species have crept up the ridge, and now *Ceanothus velutinus*, *Arctostaphylos patula*, *Horkelia pseudocapitata*, *Apocynum pumilum*, *Gayophytum ramosissimum*, and others are common. The manzanita and buck-brush are young and small but are spreading, so that in a few years the ridge, which has a warm southerly slope, will be mainly Transition. But in the meantime a new growth of Shasta firs has started, and in ten or twenty years is likely to overtop and drown out the Transition zone species, enabling the Canadian zone to reclaim the burn.

Such cases of alternation of zones resulting from the clearing of forest land are not uncommon, particularly when deforestation is caused or accompanied by fire. But on steeper slopes, especially rock slopes, if the vegetable layer is burned off, the (lower) zone which creeps up to replace the (higher) one destroyed becomes permanent or nearly so.

It may be laid down as a general rule that the destruction of forests, by admitting the sun and wind, lessens the moisture in the soil and increases the temperature, thus inviting animals and plants to come in from adjacent warmer areas. Deforestation of an area therefore tends to lower its zone position.

SLOPE EXPOSURE.

By slope exposure is meant the inclination of the earth's surface at a particular point with reference to the angle at which it receives the sun's rays. The amount of heat, were it not for the retarding effect of the atmosphere, would be greatest at noon, when the sun's position with reference to the earth is most nearly vertical. But, as everyone knows, the atmosphere becomes heated slowly and does not attain its highest temperature until the middle or latter part of the afternoon, the hour varying with the locality. Hence slopes that face the sun most nearly at a right angle at the time of day when the atmosphere is hottest are naturally the hottest slopes—those that carry the zones highest; while conversely, slopes that face the opposite direction are naturally the coldest slopes—those that depress the life zones lowest. At Portland, Oregon (about 275 miles north of Shasta), the hottest part of the day in summer is a little after 4 o'clock in the afternoon, at which time the sun is nearly due west. Consequently the hottest uncomplicated slopes are those that face west or a little south of west.

The accompanying diagram shows the actual mean hourly march of atmospheric temperature at Portland, Oregon, for June, July, and August:

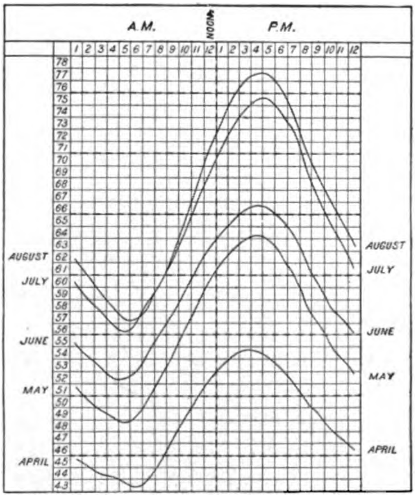

FIG. 28.—Diagram showing average hourly march of temperature.

The influence of slope exposure on the faunas and floras of mountainous regions is profound. Measured by a scale of altitudes, it amounts on ordinary slopes to nearly a thousand feet, and on steep slopes is still more marked. Thus on mountains it is usual for plants and animals of particular species to occur on warm southwesterly slopes at elevations 800 to 1,000 feet higher than on cool northeasterly slopes. Similarly on north and south ridges, the faunas and floras of the warm west slopes often belong to lower zones than those of equal elevations on the cool east slopes.

Shasta affords innumerable examples of the effects of slope exposure, both simple and complicated by canyons.

An excellent illustration of the latter is to be found in Mud Creek

Canyon, near the mouth of Clear Creek (see pl. III). The altitude of the bottom of the canyon at this point is 6,700 feet, which would naturally place it in the middle of the Canadian zone. The steep west side of the narrow ridge between the two creeks receives the afternoon sun at nearly a right angle, and is in consequence an unusually warm slope for the altitude. The result is that seeds of plants carried upward by winds and birds from the Transition zone, more than 1,000 feet below, have here found a favorable resting place and have grown into a colony of Transition zone species, among which are *Abies concolor lowiana*, *Arctostaphylos patula*, *Kunzia tridentata*, *Amelanchier alnifolia*, *Rubus parviflorus*, *Sorbus sambucifolia*, *Symphoricarpos pilosus*, *Ribes viscosissimum*, *R. amictum*, *Sambucus melanocarpa*, *Apocynum pumilum*, *Spiræa douglasi*, *Vaccinium* (*arbuscula?*), *Lupinus elmeri*, *Eriogonum marifolium*, *Gilia aggregata*, *Pteris aquilina lanuginosa*, and the large Transition zone form of *Castilleja miniata*. Just across the canyon, and in one place less than 100 feet from the lower edge of this isolated Transition colony and at a lower level, are species belonging to the Hudsonian zone—such as *Pentstemon newberryi* and *Pulsatilla occidentalis*. Thus, growing close together on opposite slopes of the same canyon, are species characteristic of zones both above and below the one to which the altitude properly belongs. This case is by no means peculiar and is a good illustration of the simpler effects of slope exposure commonly shown in mountain canyons.

Another class of cases is found on the buttes and hills. A mile and a half northeast of Wagon Camp is a conspicuous red cinder cone about 1,000 feet in height, known as Red Cone. In zone position it is well within the lower part of the Canadian belt where it is surrounded by the forest of Shasta firs, scattered trees of which push up on the basal slopes and on the south side reach the top. Just below the summit are a few silver pines belonging to the same zone. The warm southwest slope brings up from the Transition zone below thickets of manzanita, a few incense cedars, and several humbler plants. The cold northeast slope, although reaching an altitude of only about 6,800 feet, which would place it in the middle of the Canadian zone, is cold enough to bring down from the Hudsonian zone several characteristic plants, such as *Polygonum newberryi*, *Cymopterus terebinthinus*, *Cycladenia humilis*, *Eriogonum polypodum*, and *Viola purpurea*.

On the south side of Shasta an interrupted ridge or series of buttes, known collectively as 'Gray Butte,' reaches up the mountain side from Red Cone, east of Wagon Camp. northward to the gap known as 'The Gate.' In a gulch or canyon on the east side of this butte the black alpine hemlock descends more than 1,000 feet below its usual lower limit. The reason is obvious. The row of buttes cuts off the warm afternoon sun, and seepage from melting snows keeps the soil moister than in more exposed places, so that the gulch meets the two requirements of the alpine hemlock—a moist soil and a cold atmosphere. For its entire length this long tongue of hemlock is flanked by Shasta firs from the zone below, so that the usual zone relations are changed, parallel strips of Canadian and Hudsonian running up and down the mountain—instead of encircling it in the usual horizontal belts. Along Squaw Creek another tongue of alpine hemlock descends to the head of the main fall, at an altitude of about 7,250 feet, and is similarly sandwiched between ascending tongues of Shasta firs.

Between 'The [South] Gate' and the grove of alpine hemlocks on upper Squaw Creek is a prominent mass of lava 700 or 800 feet high, known as 'Red Butte.' It is about 2,000 feet below the altitude of extreme timberline and its summit is covered with trees; nevertheless its precipitous northeast side is so cold that its zone position is well above timberline, as shown by the presence there of such distinctively alpine plants as *Oxyria digyna* and *Saxifraga tolmiei*. In this case the effect of a very cold mass of rock is added to that of the coldest slope, and the result is a lowering of alpine zone species 2,000 feet below their normal elevation on the hottest southwest slopes.

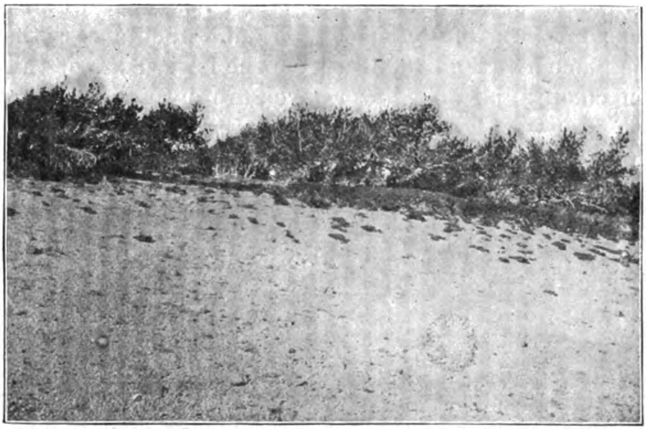

FIG. 29.—Dwarf pines ending abruptly along cold east side of ridge.

The high north and south ridges afford perhaps the simplest example of the direct influence of slope exposure. The warm west sides of these ridges usually bear trees in proportion to the availability of their slopes, while the cold east sides remain naked and alpine (see fig. 14). The way the dwarf pines stop along the east crest of the ridges is shown in the accompanying figure (fig. 29).

Finally, the glaciers of Shasta afford impressive evidence of the effects of slope exposure. My party did not take the altitudes of the glaciers, but according to the Shasta map sheet of the U. S. Geological Survey those on the cold east and northeast slopes descend below 9,000 feet, and one of them, at the head of Ash Creek, below 8,500 feet, while the only one having a south exposure (at the head of Mud Creek) stops at 11,000 feet,[1] and there are no glaciers at all on the west side. Hence if the altitudes to which glaciers descend on the various slopes be accepted as indicating the course of a sinuous line of equal temperature, it follows that the difference in temperature dependent on the angle and conditions of slope exposure, as measured by the glaciers, is equivalent to a difference of upward of 2,000 feet in altitude. But this is doubtless excessive and due in part to local influences.

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[1] There is another glacier on the south side, tributary to Mud Creek, which descends lower than the one marked on the map as 'Konwakiton glacier,' but it is completely hidden by a high ridge and is not exposed to the late afternoon sun.

EFFECTS OF STEEP SLOPES.

Steep slopes, particularly those that face the southwest and west, exaggerate the effects of slope exposure. Those that face the hot afternoon sun at nearly a right angle receive the greatest quantity of heat, but this alone is not sufficient to account for the very extraordinary degree to which the fauna and flora are sometimes affected. When it is remembered that the hottest ordinary slopes carry up the zones only 800 to 1,000 feet, one is startled to find that on some favorable steep slopes they are pushed up more than 2,000 feet above their normal limits. The explanation did not occur to me until, in discussing the matter with the geologist, G. K. Gilbert, he suggested the diurnal ascending current as the missing factor.

It is well known that in ordinary calm weather the air currents on mountain sides and in deep canyons ascend by day and descend by night. The ascending currents are warm, the descending currents cold. The night current, being in the main free from local influences that affect its temperature, must exert an essentially equal effect on all sides of a mountain; but the temperature of the ascending day current, being constantly exposed to and in fact created by the influence of the sun, must vary enormously on different slopes. The activity and effectiveness of this current increases with the steepness of the slope and the directness of its exposure to the afternoon sun. Hence the hottest normal slopes—those that face the sun at nearly a right angle during the hottest part of the day—are rendered still more potent by increased steepness, the direct exposure to the sun keeping up the supply of heat while the steepness of the slope accelerates the rate of movement of the diurnal ascending current, carrying the heated air upward a very great distance before it has time to be cooled by the general temperature of the stratum it penetrates. Thus it is that species characteristic of the Transition zone on Shasta—species which on normal southwesterly slopes attain their upper limits at an altitude of 5,500 to 5,700 feet—are in favorable places enabled to live at elevations of 7,900 and even 8,000 feet, considerably more than 2,000 feet above their normal upper limits.

The steep slopes of Diller Canyon furnish instructive illustrations of the effects of these ascending hot-air currents. Here, on the hot stony pumice slopes, such distinctive Transition zone species as *Arctostaphylos patula*, *Kunzia tridentata*, *Ceanothus velutinus*, and *Chrysothamnus-occidentalis* flourish among the Shasta firs and white-bark pines at an altitude of nearly 8,000 feet in the belt where the Canadian and Hudsonian zones overlap, and more than 2,000 feet above the extreme upper limit of their normal distribution on uncomplicated hot southwesterly slopes.

BASIN SLOPES.

Many of the glacial basins of the timberline region are broad U-shaped depressions with gently sloping bottoms, ending abruptly in terminal moraines, below which they may or may not continue on to other moraines. They were excavated by glaciers at a period when the ice cap of Shasta was much larger and more complete than at present. The upper ends of most of these valleys abut against the steep upper slopes of the peak, and are bordered on both sides by lofty ridges, so that they are walled in on three sides and thus converted into basins. Such basins, when they face the southwest, appear to promote the reflection of heat and retard the escape of hot air, so that they sometimes become hot pockets characterized by species belonging to the zone below.

LIFE ZONES OF SHASTA.

Shasta stands on a Transition zone plane, with a dilute tongue of Upper Sonoran approaching its northern base by way of Klamath and Shasta valleys. Its forested slopes rise quickly through the Boreal zones to timberline, above which its ice-clad summit towers to a height of 5,000 feet. The life zones of Shasta, therefore, beginning with the Upper Sonoran element of Shasta Valley, are—

Upper Sonoran
Transition
Canadian
Hudsonian
Arctic-Alpine.

In a generalized diagrammatic north and south section of the mountain the relations of these zones may be shown somewhat as follows:

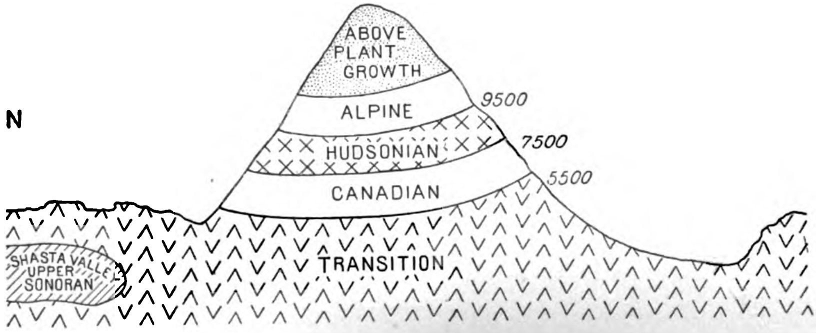

FIG. 30.—Diagram of Shasta showing relations of life zones.

The altitudes of zone boundaries here given are intended to represent their average or mean elevation on normal southerly slopes. The aridity of the mountain consequent scattered or 'spotty' instead of 'contin ost of its zone species, complicated by the influe s, springs, and air currents, elsewhere discuss ies 1,000 feet or more above or below th impossible to fix with certainty the normal zone altitudes. Hence those here given must be regarded as approximate only. The average width of the belt of overlapping of adjoining zones appears to be about 800 feet; so that the normal vertical distribution of the distinctive species of each zone overreaches in both directions the altitudes given by about 400 feet.

The zone positions accorded the various species are based on personal field experience, and in the great majority of cases are believed to be correct; in a few instances, however, the evidence is inconclusive—hence the zone lists must be regarded as provisional and subject to correction. Species recently exterminated or driven away, as the mountain sheep, elk, and grizzly bear, are included in the tables.

UPPER SONORAN ZONE.

The Upper Sonoran element in the region about Shasta is dilute and is limited to Shasta Valley at the north base of the mountain, which it reaches by way of the Klamath country on the north and northeast. It has no connection whatever with the Upper Sonoran of the Sacramento Valley on the south, which ends near the point where Pitt River joins the Sacramento, about 50 miles below Shasta.

Shasta Valley is an arid plain about 25 miles in length by 10 or 12 in breadth, studded with small volcanic buttes and lava flows. It varies in altitude from a little less than 4,000 to about 2,700 feet, and is lowest at the north, where the Shasta River, by which it is traversed, flows into the Klamath River. Shasta River is in places bordered by deciduous trees, mainly *Populus trichocarpa*, *Betula occidentalis*, and *Alnus rhombifolia*. The valley is sparsely covered with rabbit brush of several species, mainly *Chrysothamnus occidentalis* and *C. viscidiflorus*, and in some places, chiefly on the east and south, by the true sagebrush (*Artemisia tridentata*). The southeastern part contains an open forest of junipers (*Juniperus occidentalis*), which meets the pine forest of the basal slopes of the mountain. The western part is an open plain very scantily dotted with rabbit brush and a few small and mainly inconspicuous plants, among which were observed: *Mentzelia lævicaulis*, *Xanthium strumarium*, *Heliotropium curassavicum*, *Verbena bracteosa*, *Datura meteloides*, *Sarcobatus vermiculatus* and *Nicotiana sp. ?* Along the western border of the valley, near the Scott Mountains, several characteristic shrubs occur, among which are *Ceanothus cuneatus*, *Arctostaphylos* (*viscida ?*), *Cercocarpus parvifolius*, *Eriodictyon glutinosum*, and *Garrya fremonti*.[1]

The zone position of this region is further indicated by the presence of such birds as the chat (*Icteria virens longicauda*), bush-tit (*Psaltriparus minimus californicus*), California towhee (*Pipilo fuscus crissalis*), California jay (*Aphelocoma californica*), and California valley quail (*Lophortyx californicus vallicola*). Formerly antelope were common here, but now they are rarely seen. The most abundant mammals are jack rabbits (*Lepus californicus*), sagebrush cottontails (*Lepus nut*

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[1] *Garrya fremonti* is both Upper Sonoran and Transition.

talli), kangaroo rats (*Dipodomys californicus*), pocket mice (*Perognathus parvus?*), woodrats (*Neotoma fuscipes*), coyotes (*Canis ochropus*), and raccoons (*Procyon psora pacifica*).

So little work was done in Shasta Valley that the species mentioned are of course only a fraction of those present.

MAMMALS OF UPPER SONORAN ZONE (IN SHASTA VALLEY).

Restricted to Upper Sonoran.

Lepus californicus.
Lepus nuttalli.
Microtus californicus.
Perognathus (parvus?).
Peromyscus truei.
Reithrodontomys klamathensis.

Common to Upper Sonoran and Transition.

Antilocapra americana.
Canis ochropus.
Dipodomys californicus.
Mephitis occidentalis.
Myotis evotis.
Neotoma fuscipes.
Peromyscus gambeli.
Procyon psora pacifica.
Scapanus californicus.
Spermophilus douglasi.
Spilogale latifrons.
Taxidea taxus.
Vespertilio fuscus.
?Zapus pacificus.

BIRDS OF UPPER SONORAN ZONE (IN SHASTA VALLEY).

Restricted to Upper Sonoran.

Catherpes mexicanus punctulatus.
Chondestes grammacus strigatus.
Cyanocephalus cyanocephalus.[1]
Falco mexicanus.
Lanius ludovicianus excubitorides.
Otocoris alpestris merrilli.
Pipilo fuscus crissalis.
Psaltriparus minimus californicus.

Common to Upper Sonoran and Transition.

Aphelocoma californica.
Astragalinus psaltria.
Buteo swainsoni.
Calypte anna.
Carpodacus mexicanus obscurus.
Cathartes aura.
Chondestes grammacus strigatus.
Chordeiles virginianus.
Cyanospiza amœna.
Dendroica æstiva.
Geothlypis trichas occidentalis.
Icteria virens longicauda.
Lophortyx californicus vallicola.
Melanerpes formicivorus bairdi.
Phalænoptilus nuttalli.
Pipilo maculatus megalonyx.
Scolecophagus cyanocephalus.
Speotyto cunicularia hypogæa.
Spizella socialis arizonæ.
Sturnella magna neglecta.
Thryomanes bewicki spilurus.
Troglodytes aëdon parkmani.
Tyrannus verticalis.
Vireo gilvus swainsoni.
Zenaidura macroura.

TRANSITION ZONE.

Excepting Shasta Valley, the Transition zone covers the whole country about Shasta and pushes up over the basal slopes to an altitude of 5,000 or 6,000 feet. To the northeast and east it reaches and extends beyond the Klamath country and Goose Lake in Oregon, and the Madeline Plains in extreme northeastern California, interrupted only by narrow tongues of Upper Sonoran in the upper Pitt River Valley, and by small islands of Canadian on the highest mountain summits.

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[1] The piñon jay visits the juniper forests in Shasta Valley in fall to feed on the juniper berries, but whether or not it breeds there is not known.

To the south the Transition zone fills the McCloud and Pitt River valleys, embraces the canyon of the Sacramento, and stretches onward along the flanks of the Sierra all the way to southern California. To the west it overspreads the wild mountain region between Shasta and the Pacific Ocean, changing gradually from Arid Transition to Humid Transition, and surrounding the Upper Sonoran bottoms of Scott and Hoopa valleys, and the Boreal summits of Salmon, Trinity, and Siskiyou mountains. It covers the lower slopes and eastern part of the Siskiyous, and passes around the southern ends of the Salmon and Trinity mountains continuously to the sea.

On the flanks of Shasta the Transition zone forms a broad continuous belt covering the basal slopes on the northwest, west, and south, but interrupted on the cold east and northeast sides by the Boreal, which here pushes down to the actual base of the mountain, crowding the Transition out to the east around a group of low volcanic hills.

On the southwest and west it pushes up on ordinary slopes to 5,500 or 6,000 feet, rising on steep pumice canyon slopes a couple of thousand feet higher, and everywhere embracing tongues of Canadian which descend along the cold streams and on the cold easterly slopes of ridges.

On Shasta the study of the Transition zone is complicated by strong local differences of soil-moisture and humidity—differences that exert a profound effect on the distribution of plants, and to a less degree on that of animals also. It has been shown elsewhere (Life Zones and Crop Zones of the United States, p. 28, September, 1898) that in some places the Arid Transition of the Rocky Mountains and Great Basin passes gradually into the Humid Transition of the Pacific coast. On Shasta similar changes occur in such small compass that they may be studied to excellent advantage. Thus, near the south end of Shasta Valley the dominant types of vegetation are *Pinus ponderosa*, *Quercus californica*, *Artemisia tridentata*, *Kunzia tridentata*, *Arctostaphylos patula*, *Chrysothamnus occidentalis*, *Rhus trilobata*, *Garrya fremonti*, and *Prunus subcordata*, all characteristic Arid Transition species. On moister soils near by, particularly in shady canyons, the dominant types are *Pseudotsuga mucronata*, *Abies concolor lowiana*, *Acer glabrum*, *Cornus nuttalli*, *Rubus parviflorus* (=*nutkanus* Auct.) *Spiræa douglasi* and other Humid Transition species.

In this connection it is important to bear in mind that the extreme bottom of the west slope of Shasta, between the Sacramento River and Shasta Valley (elevation about 3,400 feet), is decidedly cooler and more boreal than the middle part of the slope 1,000 or 2,000 feet higher. The reason is twofold: The bottom part of the west slope, from the head of the Sacramento Canyon northward, lies close to the east base of Mount Eddy and the Scott Mountains, by which it is shielded from the late afternoon sun, and consequently receives less heat than higher parts of the same slope. Furthermore, it is well watered, and the rapid evaporation caused by the dry atmosphere tends to lower the temperature still more. Higher parts of the same slope are not only very much drier, but are exposed to the direct rays of the afternoon sun, which, owing to the increasing steepness, strike the ground more nearly at a right angle than at lower elevations, the result being a material increase in the amount of heat received. It is obvious, therefore, that on the southwest and west slopes the middle part of the Transition zone is the hottest and driest, the part in which low Transition or even Upper Sonoran species are most apt to be found, while the *upper* and *lower* parts are coolest and dampest, the parts most likely to be invaded by Canadian zone species. Hence it is not surprising that Douglas and white firs, willows, alders, elder, snowberry, red spiræa, osier, and thimbleberry flourish at the top and bottom of the Transition slope, but are absent from the middle part. At the extreme foot of the slope, along the cool streams near Sisson Tavern, two normally boreal plants occur which were not found at all in the boreal belts on the mountain. These are *Linnæa borealis* and *Pachystima myrsinites*. With them is associated the mountain chinquapin (*Castanopsis sempervirens*). There is something peculiar about the distribution of *Pachystima*. It is abundant in the neighborhood of Sisson Tavern and occurs here and there, apparently on dry soil, up to an altitude of 4,700 feet, but not above. Since all three of these species are boreal, it is possible that the forms here referred to are Transition zone subspecies.

MAMMALS OF TRANSITION ZONE.

(1) *Species known to occur in the Transition zone of Shasta.*

Antilocapra americana.
Bassariscus astutus raptor.
Callospermophilus chrysodeirus.
Canis ochropus.
Castor canadensis.[1]
Cervus occidentalis.
Dipodomys californicus.
Erethizon epixanthus.
Eutamias amœnus.
Eutamias senex.
Felis oregonensis.
Lutra hudsonica.
Lutreola vison.
Lynx fasciatus pallescens.
Mephitis occidentalis.
Microtus montanus.
Microtus mordax.[1]
Myotis evotis.
Myotis lucifugus longicrus.
Neotoma cinerea.
Neotoma fuscipes.
Neurotrichus gibbsi major.
Odocoileus columbianus.
Perognathus mollipilosus.
Peromyscus boyli.
Peromyscus gambeli.
Procyon psora pacifica.
Scapanus californicus.
Sciuropterus (klamathensis?).
Sciurus albolimbatus.
Sciurus fossor.
Sorex montereyensis.
Sorex vagrans amœnus.
Spermophilus douglasi.
Spilogale latifrons.
Taxidea taxus.
Thomomys monticola pinetorum.
Urocyon californicus townsendi.
Ursus americanus.
Ursus horribilis.
Vespertilio fuscus.
Vulpes macrourus.[2]
Zapus pacificus.

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[1] Restricted to cold streams which though traversing the Transition zone afford Boreal temperatures.

[2] Probably does not breed below Canadian.

MAMMALS OF TRANSITION ZONE—continued.

(2) *Restricted to Transition zone.*

Bassariscus astutus raptor.
Lynx fasciatus pallescens.
?Mephitis occidentalis.
?Microtus montanus.
Sciurus fossor.
Urocyon californicus townsendi.

(3) *Common to Transition and Upper Sonoran zones.*

[See p. 54.]

(4) *Common to Transition and Canadian zones.*

Callospermophilus chrysodeirus.
Cervus occidentalis.
Erethizon epixanthus.
Eutamias amœnus.
Eutamias senex.
Felis oregonensis.
Lutra hudsonica.
Lutreola vison energumenos.
Microtus mordax.
Myotis lucifugus longicrus.
Neotoma cinerea.
Neurotrichus gibbsi major.
Odocoileus columbianus.
Perognathus mollipilosus.
Peromyscus boyli.
Peromyscus gambeli.
Scapanus californicus.
Sciuropterus alpinus klamathensis?
Sciurus albolimbatus.
Sorex montereyensis.
Sorex vagrans amœnus.
Taxidea taxus.
Ursus americanus.
Ursus horribilis.
Vulpes macrourus.[1]

BIRDS OF TRANSITION ZONE.

(1) *Species known to occur in Transition zone of Shasta.*

Aphelocoma californica.
Aquila chrysaëtos.
Astragalinus psaltria.
Astragalinus tristis salicamans.
Bubo virginianus.
Buteo borealis calurus.
Buteo swainsoni.
Calypte anna.
Carpodacus mexicanus obscurus.
Cathartes aura.
Ceophlœus pileatus abieticola.
Certhia familiaris occidentalis.
Chætura vauxi.
Chondestes grammacus strigatus.
Chordeiles virginianus.
Circus hudsonius.
Colaptes cafer.
Contopus borealis.
Contopus richardsoni.
Cyanocitta stelleri.
Cyanospiza amœna.
Dendragapus obscurus fuliginosus.
Dendroica æstiva.
Dendroica auduboni.
Dryobates pubescens gairdneri.
Dryobates villosus hyloscopus.
Empidonax difficilis.
Empidonax hammondi.
Empidonax wrighti.
Falco sparverius.
Geothlypis tolmiei.
Geothlypis trichas occidentalis.
Glaucidium gnoma californicum.
Helminthophila celata lutescens.
Helminthophila rubricapilla gutturalis.
Hirundo erythrogastra.
Hylocichla aonalaschkæ auduboni.
Icteria virens longicauda.
Lophortyx californicus vallicola.
Melanerpes formicivorus bairdi.
Melanerpes torquatus.
Melospiza lincolni.
Melospiza melodia montana.
Merula migratoria propinqua.
Oreortyx pictus plumiferus.
Oreospiza chlorura.
Passerella iliaca megarhyncha.
Petrochelidon lunifrons.
Phalænoptilus nuttalli.
Pipilo maculatus megalonyx.
Piranga ludoviciana.
Scolecophagus cyanocephalus.

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[1] Supposed to breed in Canadian and wander over Transition.

BIRDS OF TRANSITION ZONE—continued.

(1) *Species known to occur in Transition zone of Shasta*—Continued.

Selasphorus rufus.
Sialia mexicana occidentalis.
Sitta carolinensis aculeata.
Sitta pygmæa.
Speotyto cunicularia hypogæa.
Sphyrapicus ruber.
Spizella socialis arizonæ.
Stellula calliope.
Sturnella magna neglecta.
Tachycineta bicolor.
Tachycineta thalassina.
Thryomanes bewicki spilurus.
Troglodytes aëdon parkmani.
Tyrannus verticalis.
Vireo gilvus swainsoni.
Vireo solitarius cassini.
?Wilsonia pusilla pileolata.
Xenopicus albolarvatus.
Zamelodia melanocephala.
Zenaidura macroura.

(2) *Restricted to Transition zone.*

?Chætura vauxi.
Contopus richardsoni.
Dryobates pubescens gairdneri.
Glaucidium gnoma californicum.
Melanerpes torquatus.
Oreospiza chlorura.
Passerella iliaca megarhyncha.
Sialia mexicana occidentalis.[1]
Sitta pygmæa.
Sphyrapicus ruber.
Vireo solitarius cassini.
Zamelodia melanocephala.[1]

(3) *Common to Transition and Upper Sonoran zones.*

[See p. 54.]

(4) *Common to Transition and Canadian zones.*

Aquila chrysaëtos.
Bubo virginianus.
Buteo borealis calurus.
Ceophlœus pileatus abieticola.
Certhia familiaris occidentalis.
Chordeiles virginianus.
Colaptes cafer.
Contopus borealis.
Cyanocitta stelleri.
Dendragapus obscurus fuliginosus.
Dendroica auduboni.
Dryobates villosus hyloscopus.
Empidonax difficilis.
Empidonax hammondi.
Empidonax wrighti.
Falco sparverius.
Geothlypis tolmiei.
Helminthophila celata lutescens.
Helminthophila rubricapilla gutturalis.
Hylocichla aonalaschkæ auduboni.
Melospiza lincolni.
Merula migratoria propinqua.
Oreortyx pictus plumiferus.
Piranga ludoviciana.
Selasphorus rufus.
Sitta carolinensis aculeata.
Stellula calliope.
Wilsonia pusilla pileolata.
Xenopicus albolarvatus.

PLANTS OF TRANSITION ZONE.

(1) *Species known to occur in the Transition zone of Shasta.*

Abies concolor lowiana.
Acer circinatum.
Acer glabrum.
Acer macrophyllum.
Achillea lanulosa.
Alnus tenuifolia.
Amelanchier alnifolia.
Anaphalis margaritacea.
Antennaria geyeri.
Apocynum pumilum.
Aquilegia truncata.
Arctostaphylos patula.
Artemisia ludoviciana.
Artemisia tridentata.
Asarum hartwegi.
Betula occidentalis.

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[1] Probably common to Transition and Upper Sonoran.

PLANTS OF TRANSITION ZONE—continued.

(1) *Species known to occur in Transition zone of Shasta*—Continued.

Carum gairdneri.
Castanopsis sempervirens.
Ceanothus cordulatus.
Ceanothus integerrimus.
Ceanothus (Cerastes) prostratus.
Ceanothus velutinus.
Cerasus demissa.
Cerasus emarginata.
Cerasus glandulosa.
Cercocarpus ledifolius.
Cercocarpus parvifolius.
Chamæsaracha nana.
Chimaphila menziesi.
Chimaphila umbellata.
Chrysamphora californica.
Chrysothamnus bloomeri angustatus.
Chrysothamnus occidentalis.
Cornus nuttalli.
Cornus pubescens.
Corylus rostrata californica.
Cratægus rivularis.
Cryptanthe geminata.
Epilobium brevistylum.
Epilobium oregonense.
Epilobium spicatum.
Eriogonum marifolium.
Eriogonum nudum.
Eupatorium occidentale.
Fragaria bracteata.
Fragaria chiloensis.
Fraxinus oregana.
Fritillaria atropurpurea.
Gayophytum ramosissimum.
Gilia aggregata.
Gilia (Collomia) grandiflora.
Hastingsia alba.
Heleniastrum rivulare.
Heracleum lanatum.
Hieracium albiflorum (large form).
Hieracium cynoglossoides nudicaule.
Hieracium greenei.
Horkelia pseudocapitata.
Juniperus occidentalis.
Kunzia tridentata.
Lappula nervosa.
Libocedrus decurrens.
Lilium washingtonianum.
Linnæa borealis.
Linum lewisi.
Lotus americanus.
Lupinus elmeri.
Lupinus minimus.
Machæranthera shastensis (large form)
Mimulus moniliformis.
Mimulus tilingi.
Osmorrhiza nuda.
Pachystima myrsinites.
Pæonia browni.
Pentstemon confertus (form not typical).
Phacelia magellanica.
Pinus attenuata.
Pinus lambertiana.
Pinus ponderosa.
Polygala cornuta.
Populus trichocarpa.
Potentilla glandulosa (large form).
Prunus subcordata.
Pseudotsuga mucronata.
Ptiloria lactucina.
Pyrola picta.
Pyrola secunda.
Quercus californica.
Rhamnus californica (or rubra).
Rhus trilobata.
Ribes amictum.
Ribes cereum.
Ribes klamathense.
Ribes viscosissimum.
Rosa californica.
Rosa gymnocarpa.
Rubus parviflorus.
Rubus vitifolius.
Salix lasiandra.
Salix nuttalli.
Salix sitchensis.
Sambucus melanocarpa.
Sisyrinchium bellum.
Smilax californica.
Solidago elongata.
Sorbus sambucifolia.
Spiræa douglasi.
Stachys ingrata.
Symphoricarpos pilosus.
Symphoricarpos racemosus.
Tritelia ixioides.
Vaccinium arbuscula.
Vagnera stellata.

PLANTS OF TRANSITION ZONE—continued.

(2) *Species restricted to Transition zone.*

Abies concolor lowiana.
Acer circinatum.
Acer glabrum.*
Acer macrophyllum.
Achillea lanulosa.
Alnus tenuifolia.
Amelanchier alnifolia.*
Anaphalis margaritacea.
Antennaria geyeri.
Apocynum pumilum.
Aquilegia truncata.
Arctostaphylos patula.
Artemisia ludoviciana (form).
Asarum hartwegi.
Ceanothus cordulatus.
Ceanothus integerrimus.
Ceanothus (Cerastes) prostratus.
Ceanothus velutinus.
Cerasus demissa.
Cerasus emarginata.
Cerasus glandulosa.
Cercocarpus ledifolius.
Chrysamphora californica.
Chrysothamnus bloomeri angustatus.
Cornus nuttalli.
Cornus pubescens.*
Corylus rostrata californica.
Cratægus rivularis.*
Cryptanthe geminata.
Fragaria bracteata.
Fragaria chiloensis.
Fritillaria atropurpurea.
Gayophytum ramosissimum.
Gilia (Collomia) grandiflora.
Hastingsia alba.
Hieracium albiflorum (large form).
Hieracium cynoglossoides nudicaule.
Hieracium greenei.
Horkelia pseudocapitata.
Lappula nervosa.
Libocedrus decurrens.
Lilium washingtonianum.
Linnæa borealis.*[1]
Linum lewisi.
Lotus americanus.
Lupinus minimus.
Osmorrhiza nuda.
Pachystima myrsinites.*
Pæonia browni.
Pinus attenuata.
Pinus lambertiana.
Pinus ponderosa.
Polygala cornuta.
Pseudotsuga mucronata.
Quercus californica.
Rhamnus californica (or rubra).
Ribes klamathense.
Ribes viscosissimum.
Rosa californica.
Rosa gymnocarpa.
Rubus parviflorus.*
Rubus vitifolius.
Salix lasiandra.
Sambucus melanocarpa.
Sisyrinchium bellum.
Smilax californica.
Solidago elongata.
Symphoricarpos pilosus.
Symphoricarpos racemosus.

In other mountains the species marked with an asterisk (*) are believed to occur in the Canadian zone as well as the Transition.

(3) *Species common to Transition and Upper Sonoran zones.*

Alnus rhombifolia.
Artemisia tridentata.
Betula occidentalis.
Cercocarpus parvifolius.
Chrysothamnus occidentalis.
Eriogonum nudum.
Fraxinus oregana.
Juniperus occidentalis.
Kunzia tridentata.
? Populus trichocarpa.
Prunus subcordata.
Rhus trilobata.

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[1] *Linnæa borealis* is ordinarily a Boreal plant, but it was not found in the Boreal belt of Shasta, though common in places at Sisson. The Sisson form has been separated as var. *longiflora*, and may be worthy of recognition as a Transition zone subspecies.

PLANTS OF TRANSITION ZONE—continued.

(4) Species common to Transition and Canadian zones.

(Or growing on boundary between.)

Carum gairdneri.
Castanopsis sempervirens.
Castilleja miniata.
Chamæsaracha nana.
Chimaphila menziesi.
Chimaphila umbellata.
Epilobium brevistylum.
Epilobium oregonense.
Epilobium spicatum.
Eriogonum marifolium.
Eupatorium occidentale.
Gilia aggregata.
Heleniastrum rivulare.
Heracleum lanatum.
Lupinus elmeri.
Machæranthera shastensis (large form).
Mimulus moniliformis.
Mimulus tilingi.
Pentstemon confertus (form not typical).
Phacelia magellanica.
Potentilla glandulosa (large form).
Ptiloria lactucina.
Pyrola picta.
Pyrola secunda.
Ribes amictum.
Ribes cereum.
Salix nuttalli.
Salix sitchensis.
Sorbus sambucifolia.
Spiræa douglasi.
Stachys ingrata.
Tritelia ixioides.
Vaccinium arbuscula.
Vagnera stellata.

CANADIAN ZONE.

The Canadian zone on Shasta forms a broad forest belt, usually several miles in width and about 2,000 feet in vertical depth, which completely encircles the mountain. On southwesterly slopes it begins at an altitude of about 5,000 to 5,500 feet and pushes up to 7,500 to 7,800 feet.

Excepting an area of lodge-pole pines (*Pinus murrayana*) on the northeast base of the mountain, the Canadian zone is everywhere marked by a continuous forest of stately trees, consisting of Shasta firs (*Abies shastensis*), mixed in places with silver pines (*Pinus monticola*). It is a dark, somber forest, growing on a blackish soil, with very little noticeable vegetation except scattered patches of dwarf manzanita in the dry woods, and lines of more succulent plants at widely distant intervals along the borders of streams.

MAMMALS OF CANADIAN ZONE.

(1) *Species known to occur in Canadian zone on Shasta.*

Aplodontia major.
Callospermophilus chrysodeirus.
Canis lestes.
Cervus occidentalis.
Erethizon epixanthus.
Eutamias amœnus.
Eutamias senex.
Evotomys mazama.
Felis oregonensis.
Lepus klamathensis.
Lutra hudsonica.
Lutreola vison energumenos.
Microtus mordax.
Mustela caurina.
Mustela pennanti.
Myotis lucifugus longicrus.
Myotis yumanensis saturatus.
Neotoma cinerea.
Neurotrichus gibbsi major.
Odocoileus columbianus.
Perognathus mollipilosus.
Peromyscus boyli.

MAMMALS OF CANADIAN ZONE—continued.

(1) *Species known to occur in Canadian zone on Shasta*—Continued.

Peromyscus gambeli.
Putorius arizonensis.
Scapanus californicus.
Sciuropterus alpinus klamathensis?.
Sciurus albolimbatus.
Sorex montereyensis.
Sorex (Neosorex) navigator.
Sorex shastensis.
Sorex vagrans amœnus.
Taxidea taxus.
Thomomys monticola.
Ursus americanus.
Ursus horribilis.
Vulpes macrourus.
Zapus trinotatus alleni.

(2) *Species restricted to Canadian zone.*

Aplodontia major.
? Sorex (Neosorex) navigator.
Sorex shastensis.
Zapus trinotatus alleni.

(3) *Species common to Canadian and Transition zones.*

[See p. 57.]

(4) *Species common to Canadian and Hudsonian zones.*

Callospermophilus chrysodeirus.
Canis lestes.
Erethizon epixanthus.
Eutamias amœnus.
Eutamias senex.
Evotomys mazama.
Lepus klamathensis.
Microtus mordax.
Mustela caurina.
Mustela pennanti.
Myotis yumanensis saturatus.
Neotoma cinerea.
Odocoileus columbianus.
Perognathus mollipilosus.
Peromyscus gambeli.
Putorius arizonensis.
Sorex vagrans amœnus.
Thomomys monticola.
Vulpes macrourus.

BIRDS OF CANADIAN ZONE.

(1) *Species known to occur in Canadian zone on Shasta.*

Accipiter atricapillus striatulus.
Accipiter velox.
Aquila chrysaëtos.
Bubo virginianus.
Buteo borealis calurus.
Carpodacus cassini.
Ceophlœus pileatus abieticola.
Certhia familiaris occidentalis.
Chordeiles virginianus.
Cinclus mexicanus.
Coccothraustes vespertinus montanus.
Colaptes cafer.
Contopus borealis.
Cyanocitta stelleri.
Dendragapus obscurus fuliginosus.
Dendroica auduboni.
Dendroica occidentalis.
Dryobates villosus hyloscopus.
Empidonax difficilis.
Empidonax hammondi.
Empidonax wrighti.
Falco sparverius.
Geothlypis tolmiei.
Helminthophila celata lutescens.
Helminthophila rubricapilla gutturalis.
Hylocichla aonalaschkæ auduboni.
Junco hyemalis thurberi.
Loxia curvirostra bendirei.
Melospiza lincolni.
Merula migratoria propinqua.
Myadestes townsendi.
Oreortyx pictus plumiferus.
Parus gambeli.
Perisoreus obscurus.
Picoides arcticus.
Piranga ludoviciana.
Regulus calendula.
Regulus satrapa olivaceus.
Selasphorus rufus.
Sitta canadensis.
Sitta carolinensis aculeata.
Sphyrapicus thyroideus.
Spinus pinus.
Stellula calliope.
Wilsonia pusilla pileolata.
Xenopicus albolarvatus.

BIRDS OF CANADIAN ZONE—continued.

(2) *Species restricted to Canadian zone.*

Loxia curvirostra bendirei.
Melospiza lincolni.
Picoides arcticus.

(3) *Species common to Canadian and Transition zones.*

[See p. 58.]

(4) *Species common to Canadian and Hudsonian zones.*

Accipiter atricapillus striatulus.
Accipiter velox.
Aquila chrysaëtos.
Carpodacus cassini.
Cinclus mexicanus.
Coccothraustes vespertinus montanus.
Dendragapus obscurus fuliginosus.
Dendroica auduboni.
Dendroica occidentalis.
Falco sparverius.
Junco hyemalis thurberi.
? Loxia curvirostra bendirei.
Myadestes townsendi.
Parus gambeli.
Perisoreus obscurus.
Regulus calendula.
Regulus satrapa olivaceus.
Selasphorus rufus.
Sitta canadensis.
Sphyrapicus thyroideus.
Spinus pinus.
Stellula calliope.

PLANTS OF CANADIAN ZONE.

(1) *Species known to occur in Canadian zone on Shasta.*

Abies shastensis.
Aconitum columbianum.
Allium validum.
Alnus sinuata.
Arctostaphylos nevadensis.
Arnica longifolia.
Campanula wilkinsiana.
Carum gairdneri.
Castanopsis sempervirens.
Castilleja miniata.
Chamæsaracha nana.
Chimaphila menziesi.
Chimaphila umbellata.
Chrysothamnus bloomeri.
Corallorhiza bigelovi.
? Crepis intermedia.
Cymopteris terebinthinus (large form).
Delphinium sonnei.
Drosera rotundifolia.
Epilobium brevistylum.
Epilobium oregonense.
Epilobium spicatum.
Erigeron inornatus.
Eriogonum marifolium.
Eupatorium occidentale.
Gentiana simplex.
Gilia aggregata.
Habenaria leucostachys.
Habenaria unalaschensis.
Heleniastrum rivulare.
Heracleum lanatum.
Holodiscus discolor (large form).
Hypericum anagalloides.
Ligusticum grayi.
Lilium parvum.
Lupinus elmeri.
Madia bolanderi.
Machæranthera shastensis (large form).
Mimulus moniliformis.
Mimulus primuloides.
Mimulus tilingi.
Monardella odoratissima.
Pentstemon confertus (form not typical).
Pentstemon deustus.
Pentstemon gracilentus.
Phacelia magellanica.
Phlox douglasi diffusa.
Pinus monticola.
Pinus murrayana.
Potentilla glandulosa (large form).
Ptiloria lactucina.
Pyrola pallida.
Pyrola picta.
Pyrola secunda.
Ribes amictum.
Ribes cereum.
Salix nuttalli.
Salix sitchensis.
Senecio trigonophyllus.
Sorbus sambucifolia.

PLANTS OF CANADIAN ZONE—continued.

(1) *Species known to occur in Canadian zone on Shasta*—Continued.

Spiræa douglasi.
Spraguea umbellata.
Stachys ingrata.
Stellaria crispa.
Tofieldia occidentalis.
Tritelia ixioides.
Vaccinium occidentale.
Vagnera stellata.
Veratrum californicum.
Viola blanda.

(2) *Species restricted to Canadian zone.*

Abies shastensis.
Aconitum columbianum.
Allium validum.
Alnus sinuata.
Arnica longifolia.
?Corallorhiza bigelovi.
Delphinium sonnei.
Drosera rotundifolia.
Erigeron inornatus.
Gentiana simplex.
Habenaria leucostachys.
Habenaria unalaschensis.
Lilium parvum.
Madia bolanderi.
Pentstemon deustus.
Pentstemon gracilentus.
Pinus monticola.
Pinus murrayana.
Pyrola pallida.
Senecio trigonophyllus.
Tofieldia occidentalis.
Vaccinium occidentale.
Viola blanda.

(3) *Species common to Canadian and Transition zones.*

[See p. 61.]

(4) *Species common to Canadian and Hudsonian zones.*

Arctostaphylos nevadensis.
Campanula wilkinsiana.
Castanopsis sempervirens.
Castilleja miniata.
Chrysothamnus bloomeri.
Holodiscus discolor.
Hypericum anagalloides.
Ligusticum grayi.
Mimulus primuloides.
Monardella odoratissima.
Phlox douglasi diffusa.
Ribes cereum.
Spraguea umbellata.
Stellaria crispa.

HUDSONIAN ZONE.

The Hudsonian zone is the highest of the timber belts. Its sinuous upper border rises on the high ridges to inclose the narrow tongues of dwarf prostrate trees that push up on the warmest southwesterly exposures to an extreme altitude of 9,800 feet, but between the ridges it dips down a thousand feet or more, and is difficult to fix with precision. The lower border slightly overlaps the upper limit of Shasta firs. Two species of trees, and only two, grow in this zone—the black alpine hemlock (*Tsuga mertensiana*) and the white-bark pine (*Pinus albicaulis*). The hemlock is restricted to local spots, while the white-bark pine forms a practically continuous belt, as already explained (see p. 42). On warm southwesterly slopes the Hudsonian reaches from 7,500 or 7,800 up to 9,500, or in extreme cases to 9,800 feet.

MAMMALS OF HUDSONIAN ZONE.

(1) *Species known to occur in Hudsonian zone of Shasta.*

Callospermophilus chrysodeirus.
Canis lestes.
Erethizon epixanthus.
Eutamias amœnus.
Eutamias senex.
Evotomys mazama.
Lepus klamathensis.
Microtus mordax.
Mustela caurina.
Mustela pennanti.
Myotis yumanensis saturatus.
Neotoma cinerea.
Ochotona schisticeps.
Odocoileus columbianus.
Ovis canadensis.
Perognathus mollipilosus.
Peromyscus gambeli.
Phenacomys orophilus.
Putorius arizonensis.
? Sorex vagrans amœnus.[1]
? Sorex (Neosorex) navigator.[1]
Thomomys monticola.
Vulpes macrourus.
? Zapus trinotatus alleni.[1]

(2) *Species restricted to Hudsonian zone.*

Ochotona schisticeps.

(3) *Species common to Hudsonian and Canadian zones.*

[See p. 62.]

(4) *Species common to Hudsonian and Alpine zones.*

Canis lestes.[2]
Microtus mordax.
Ovis canadensis.
Peromyscus gambeli.
Phenacomys orophilus.
Thomomys monticola.
Vulpes macrourus. [2]

BIRDS OF HUDSONIAN ZONE.

(1) *Species known to occur in Hudsonian zone on Shasta.*

(Species queried are not positively known to breed in the Hudsonian, though frequently seen in this belt in July and August.)

Accipiter atricapillus striatulus.
Accipiter velox.
Aquila chrysaetos.
Carpodacus cassini.
?Certhia familiaris occidentalis.
Cinclus mexicanus.
?Coccothraustes vespertinus montanus.
Dendragapus obscurus fuliginosus.
?Dendroica auduboni.
Dendroica occidentalis.
Falco sparverius.
Junco hyemalis thurberi.
?Loxia curvirostra bendirei.
Myadestes townsendi.
Nucifraga columbiana.
Parus gambeli.
Perisoreus obscurus.
Regulus calendula.
Regulus satrapa olivaceus.
Salpinctes obsoletus.
Selasphorus rufus.
Sialia arctica.
Sitta canadensis.
?Sitta carolinensis aculeata.
Sphyrapicus thyroideus.
Spinus pinus.
Stellula calliope.
Zonotrichia leucophrys.

(2) *Species restricted to Hudsonian zone.*

Nucifraga columbiana.
Zonotrichia leucophrys.

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[1] These three species occur along the lower edge of the Hudsonian zone, but were not obtained in its upper part, and it is not certain whether or not they should be included.

[2] Does not breed above Hudsonian.

BIRDS OF HUDSONIAN ZONE—continued.

(3) *Species common to Hudsonian and Canadian zones.*

[See p. 63.]

(4) *Species common to Hudsonian and Alpine zones.*

Salpinctes obsoletus.[1]
Sialia arctica.
Stellula calliope.

PLANTS OF HUDSONIAN ZONE.

(1) *Species known to occur in Hudsonian zone on Shasta.*

Agoseris monticola.
Allium sp. —— ?
Antennaria media.
Arabis platysperma.
Arctostaphylos nevadensis.
Arnica merriami.
Arnica viscosa.
Campanula wilkinsiana.
Carex breweri.
Castanopsis sempervirens.
Castilleja affinis.
Castilleja miniata (small form).
Cheiranthus perennis.
Chrysothamnus bloomeri.
Crepis intermedia.
Cycladenia humilis.
Cymopterus terebinthinus.
Epilobium clavatum.
Epilobium obcordatum.
Epilobium pringleanum.
Erigeron armeriæfolium.
Eriogonum polypodum.
Eriogonum pyrolæfolium.
Hieracium albiflorum (alpine form).
Hieracium gracile.
Hieracium horridum.
Holodiscus discolor.
Hypericum anagalloides.
Juncus parryi.
Juniperus nana.
Kalmia glauca microphylla.
Ligusticum grayi.
Lupinus albifrons.
Lupinus 'ornatus.'
Lutkea pectinata.
Machæranthera shastensis.
Mimulus implexus.
Mimulus primuloides.
Mitella pentandra.
Monardella odoratissima.
Oreastrum alpiginum.
Oreobroma triphylla.
Orthocarpus pilosus.
Parnassia californica.
Pentstemon glaber utahensis.
Pentstemon menziesi.
Pentstemon newberryi.
Phlox douglasi diffusa.
Phyllodoce empetriformis.
Pinus albicaulis.
Polygonum newberryi.
Polygonum shastense.
Potentilla flabellifolia.
Potentilla pseudorupestris.
Pulsatilla occidentalis.
Ribes cereum.
Saxifraga bryophora.
Scutellaria nana.
Sibbaldia procumbens.
Silene grayi.
Sitanion cinereum.
Spraguea umbellata.
Stellaria crispa.
Streptanthus orbiculatus.
Tsuga mertensiana.
Vaccinium cæspitosum.
Veronica cusicki.
Viola purpurea.

(2) *Species restricted to Hudsonian zone.*

Allium sp. —— ?
Arnica merriami.
Arnica viscosa.
?Castilleja affinis.
Castilleja miniata (small form).
Cycladenia humilis.
Epilobium clavatum.
Epilobium obcordatum.

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[1] On Shasta the rock wren is restricted closely to the Alpine and Hudsonian zones, but in other places it occurs much lower down, and was recently found in Shasta Valley by W. K. Fisher.

PLANTS OF HUDSONIAN ZONE—continued.

(2) *Species restricted to Hudsonian zone*—Continued.

Epilobium pringleanum.
Holodiscus discolor (typical form).
Juniperus nana.
Kalmia glauca microphylla.
Mimulus implexus.
Mitella pentandra.
Oreobroma triphylla.
Orthocarpus pilosus.
Parnassia californica.
Pentstemon glaber utahensis.
Pentstemon newberryi.
Phyllodoce empetriformis.
Pinus albicaulis.
Potentilla flabellifolia.
Potentilla pseudorupestris?
Scutellaria nana.
Tsuga mertensiana.
Vaccinium cæspitosum.

(3) *Species common to Hudsonian and Canadian zones.*

[See p. 64.]

(4) *Species common to Hudsonian and Alpine zones.*

Agoseris monticola.
Antennaria media.
Arabis platysperma.
Carex breweri.
Cheiranthus perennis.
Chrysothamnus bloomeri.
Cymopterus terebinthinus.
Erigeron armeriæfolium.
Eriogonum polypodum.
Eriogonum pyrolæfolium.
Hieracium albiflorum (alpine form).
Hieracium gracile.
Hieracium horridum.
Juncus parryi.
Ligusticum grayi.
Lupinus 'ornatus.'
Lutkea pectinata.
Machæranthera shastensis.
Oreastrum alpiginum.
Pentstemon menziesi.
Phlox douglasi diffusa.
Polygonum newberryi.
Polygonum shastense.
Pulsatilla occidentalis.
Sibbaldia procumbens.
Silene grayi.
Sitanion cinereum.
Spraguea umbellata.
Streptanthus orbiculatus.
Veronica cusicki.
Viola purpurea.

ALPINE ZONE.

The Alpine zone occupies the irregular belt of pumice and lava between timberline and the upper limit of plant growth. On the warmer southwesterly slopes its lower limit may be found at 9,500 to 9,800 feet, but on ordinary slopes it is considerably lower. The great majority of its species stop at or below an altitude of 11,000 feet, but on the relatively warm southwesterly slopes *Hulsea nana* was found at 11,300 feet, and two species, *Draba breweri* and *Polemonium pulchellum*, as high as 13,000 feet—the extreme limit of plant growth on Shasta.

MAMMALS OF ALPINE ZONE.

(1) *Species known to occur in Alpine zone on Shasta.*

Canis lestes.[1]
Microtus mordax.
Ovis canadensis.
Peromyscus gambeli.
Phenacomys orophilus.
Thomomys monticola.
Vulpes macrourus.[1]

(2) *Species restricted to Alpine zone.*

None.

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[1] The coyote and fox range up into the Alpine zone, but do not breed above the Hudsonian and possibly not above the Canadian.

MAMMALS OF ALPINE ZONE—continued.

(3) *Species common to Alpine and Hudsonian zones.*

[See p. 65.]

BIRDS OF ALPINE ZONE.

(1) *Species known to occur in Alpine zone on Shasta.*

Anthus pensilvanicus.
Leucosticte tephrocotis.
Nucifraga columbiana.
Salpinctes obsoletus.
Sialia arctica.
Stellula calliope.

(2) *Species restricted to Alpine zone.*

Anthus pensilvanicus.
Leucosticte tephrocotis.

(3) *Species common to Alpine and Hudsonian zones.*

[See p. 66.]

PLANTS OF ALPINE ZONE.

(1) *Species known to occur in Alpine zone on Shasta.*

Achillea borealis.
Agoseris monticola.
Antennaria media.
Arabis platysperma.
Bikukulla uniflora.
Cardamine bellidifolia pachyphylla.
Carex breweri.
Chænactis nevadensis.
Cheiranthus perennis.
Chrysothamnus bloomeri.
Cymopterus terebinthinus.
Draba breweri.
Erigeron armeriæfolium.
Erigeron compositus trifidus.
Eriogonum polypodum.
Eriogonum pyrolæfolium.
Hieracium albiflorum (alpine form).
Hieracium gracile.
Hieracium horridum.
Hulsea larseni.
Hulsea nana.
Juncus parryi.
Ligusticum grayi.
Lupinus lyalli.
Lupinus 'ornatus.'
Lutkea pectinata.
Machæranthera shastensis.
Oreastrum alpiginum.
Oxyria digyna.
Pentstemon menziesi.
Phacelia frigida.
Phlox douglasi diffusa.
Polemonium pulchellum.
Polygonum newberryi.
Polygonum shastense.
Pulsatilla occidentalis.
Sagina saginoides.
Saxifraga tolmiei.
Senecio canus.
Sibbaldia procumbens.
Silene grayi.
Silene suksdorfi.
Sitanion cinereum.
Spraguea umbellata.
Streptanthus orbiculatus.
Veronica cusicki.
Viola purpurea.

(2) *Species restricted to Alpine zone.*

Achillea borealis.
Bikukulla uniflora.
Cardamine bellidifolia pachyphylla.
Chænactis nevadensis.
Draba breweri.
Erigeron compositus trifidus.
Hulsea larseni.
Hulsea nana.
Lupinus lyalli.
Oxyria digyna.
Phacelia frigida.
Polemonium pulchellum.
Sagina saginoides.
Saxifraga tolmiei.
Senecio canus.
Silene suksdorfi.

(3) *Species common to Alpine and Hudsonian zones.*

[See p. 67.]

THE BOREAL FAUNA AND FLORA OF SHASTA CONTRASTED WITH CORRESPONDING FAUNAS AND FLORAS OF THE SIERRA AND THE CASCADES.

In considering the relations of the boreal faunas and floras of Shasta to those of other parts of the Sierra-Cascade system it is necessary at the outset to have a clear conception not only of the extent of the range as a whole, but also of the number and magnitude of the breaks or gaps in the continuity of its boreal fauna and flora. The Cascade Range enters the State of Washington from British Columbia in latitude 49° and pushes southward completely across Washington and Oregon; its continuation, the Sierra Nevada, traverses California for a distance of 500 miles, ending a little south of Mount Whitney, in about latitude 36°. The Cascade-Sierra system, therefore, extends over 13 degrees of latitude, and has a total length of fully 1,000 miles. For the whole of this distance it rises abruptly from a low region, whose faunas and floras are in the southern part Sonoran, in the northern part Transition. The field work of the Biological Survey has shown that the narrow boreal band which occupies the higher parts of the range is not continuous, but is interrupted by four important gaps, through which Transition zone species pass freely in broad belts from one side to the other. These gaps, begining at the north, are:

(1) The *Columbia Gap*, or gorge of the Columbia River, on the boundary between Washington and Oregon, where the breadth of the Transition zone seems to be less than 50 miles.[1]

(2) The *Klamath Gap*, on the boundary between Oregon and California, extending from a little south of Mount Pitt in Oregon to Mount Shasta in California, a distance of about 50 miles. This interval is interrupted by one or two detached groups of low mountains on the California side, and by long ridges on both sides, whose summits are inhabited by boreal species, materially decreasing the actual breadth of the gap.

(3) The *Pitt River Gap*, between Mounts Shasta and Lassen in northern California. The breadth of the Transition zone here is about 60 miles.

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[1] Although not bearing on the fauna of Shasta, it is interesting to note, in connection with the effects of the Columbia River Gap, that a number of species characteristic of the northern Cascades, in the State of Washington, do not occur in the southern Cascades, in Oregon. Among the mammals the most notable species of this kind are *Arctomys caligatus*, *Callospermophilus saturatus*, *Evotomys gapperi saturatus*, *Oreamnos montanus*, *Peromyscus oreas*, *Putorius washingtoni*, *Zapus trinotatus*.

(4) The *Feather River* or *Quincy Gap*, between Mount Lassen and the high ridge northwest of Honey Lake—the northern end of the Sierra proper. This gap is the shallowest, narrowest, most irregular, and least effective of all, and is the only one which has not been cut deeply and completely through the range by a large river. The Boreal zones of the two sides, at the points where they come nearest together, which is southeast of the southeastern extension of the boreal plateau on which Lassen stands, are not separated, apparently, by more than 15 miles. The distance between the Hudsonian elements appears to be several times greater. This region needs further exploration.

Fully half of the boreal species of Shasta are common to both the Sierra Nevada and the Cascade Range, and some of them extend over the entire length of the Sierra-Cascade system, inhabiting the principal boreal summits all the way from British Columbia to Mount Whitney; others are restricted to particular parts of the mountains, and each of the four gaps mentioned forms a barrier beyond which certain species do not pass. Therefore, in contrasting the boreal faunas and floras of Shasta with corresponding faunas and floras of the Sierra Nevada and Cascade Range it is necessary to fix definite limits to the terms employed. The term 'Sierra,' as used in the table headings and following discussion, is restricted to the lofty range extending from Mount Whitney northward a little beyond Honey Lake; the 'Cascades,' to the Cascades of Oregon. In other words, the term 'Sierra' is restricted so as *not* to include Shasta or Lassen;[1] the term 'Cascades' so as *not* to include the Cascades of Washington.

The paucity of animal and plant life on Shasta, contrasted with that of the Sierra and Cascades, has been already noted and is clearly shown in the following tables. The explanation, briefly stated, is that Shasta, on account of its aridity and relatively small area, is incapable of supporting so rich a fauna and flora as either of the extensive ranges between which it is situated. It is not assumed that all of the boreal species inhabiting Shasta were discovered by us, but in the case of the Canadian and Hudsonian mammals and birds, and the Hudsonian and Alpine plants it is believed that the number which escaped detection is too small to materially alter the results here given.[2]

In grouping the species for study it seems most logical to arrange the mammals, birds, and plants in two principal categories: (*a*) Boreal species that occur on Shasta, with reference to their occurrence in the Sierra or Cascades or both; and (*b*) Boreal species that occur on the Sierra or the Cascades or both, but which, so far as known, are absent from Shasta.

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[1] The flora and fauna of Lassen are not known in sufficient detail to admit of complete comparisons in either direction; hence this mountain is omitted from consideration in the accompanying tables. At the same time it should be stated that Lassen is clearly a part of the Sierra, so far as its fauna is concerned.

[2] The accompanying percentages and lists of species are provisional and subject to revision. They are based on present information and will, of course, be corrected and supplemented by future field work. They are sufficiently near the truth, however, to demonstrate certain facts and warrant certain deductions and generalizations of very great interest in connection with the origin of the boreal faunas and floras of the Sierra Nevada and Cascade Range.

BOREAL SPECIES OF SHASTA CONSIDERED WITH REFERENCE TO THEIR PRESENCE OR ABSENCE IN THE SIERRA AND THE CASCADES.

The boreal mammals, birds, and plants of Shasta have been grouped in four categories· (1) species common to Shasta and the Sierra-Cascade system as a whole; (2) species common to Shasta and the Sierra, but not known from the Cascades; (3) species common to Shasta and the Cascades but not known from the Sierra, and (4) Shasta species not known from either the Sierra or the Cascades.

Thirty-six distinctively Boreal mammals are known from Shasta, including the boreal species which range down into or through the Transition zone. Of these, 26 are common to the Sierra on the south and the Cascades on the north, 7 are common to Shasta and the Sierra but are not known from the Cascades, 1 is common to Shasta and the Cascades but is not known from the Sierra, and 2 are peculiar to Shasta.

Of the 36 distinctively Boreal mammals of Shasta, 17 are believed to be exclusively boreal. Of these, 12 are common to the Sierra and the Cascades, 4 are common to Shasta and the Sierra but are not known from the Cascades, 1 is peculiar to Shasta, but not one is common to Shasta and the Cascades which does not occur also in the Sierra.

Forty-seven distinctively Boreal birds are known from Shasta, including the boreal species which range down into or through the Transition zone. Of these, 41 are common to the Sierra and the Cascades, 4 are common to Shasta and the Sierra but are not known from the Cascades, and 2 are common to Shasta and the Cascades but are not known from the Sierra.

Of the 47 distinctively Boreal birds of Shasta, 22 are believed to be exclusively boreal. Of these, 18 are common to the Sierra and the Cascades, 2 are common to Shasta and the Sierra but are not known from the Cascades, and 2 are common to Shasta and the Cascades but are not known from the Sierra.

One hundred and twelve distinctively Boreal plants are known from Shasta, including the boreal species which range down into or through the Transition zone. Of these 55 are common to the Sierra and the Cascades; 31 are common to Shasta and the Sierra but are not known from the Cascades; 16 are common to Shasta and the Cascades but are not known from the Sierra, and 8 occur on Shasta which are not known from either the Sierra or the Cascades.

Of the 112 distinctively Boreal plants of Shasta, 101 are believed to be exclusively boreal. Of these, 47 are common to the Sierra and the Cascades; 28 are common to Shasta and the Sierra but are not known from the Cascades; 15 are common to Shasta and the Cascades but are not known from the Sierra; and 8 are restricted to Shasta.

Three mammals, 5 birds, and 68 plants are believed to be restricted to the Hudsonian and Alpine zones. Of these, 2 mammals, 3 birds, and 30 plants are common to the Sierra and the Cascades; one mammal, 1 bird, and 18 plants are common to Shasta and the Sierra but are not known from the Cascades; and no mammal, 1 bird, and 12 plants are common to Shasta and the Cascades, but are not known from the Sierra. Five Hudsonian-Alpine plants from Shasta are not known from either the Sierra or the Cascades.

These comparisons show:

(1) That of the boreal species known from Shasta, including those which range down into the Transition zone, 87 percent of the birds, 72 percent of the mammals, and only 50 percent of the plants are common to the Sierra and the Cascades.

(2) That of the exclusively boreal species known from Shasta, 85 percent of the birds, 70 percent of the mammals, and 46 percent of the plants are common to the Sierra and the Cascades.

(3) That of the exclusively Hudsonian and Alpine species known from Shasta, 60 percent of the birds, 67 percent of the mammals, and 44 percent of the plants are common to the Sierra and the Cascades.

(4) That in each instance, as would be expected, the percentage of species common to the two ranges is greater in the case of those ranging down into the Transition zone than in those restricted to the Boreal, for the obvious reason that geographically the Boreal belt is broken by broad gaps, while the Transition zone is practically continuous.

(5) That of the birds, mammals, and plants of Shasta, birds have by far the largest percentage of species common to the Sierra and the Cascades, mammals next, and plants least of all. This corresponds with the relative powers of dispersion possessed by these groups.

Arranged primarily by groups instead of zone limits, it appears that the percentages of Shasta birds common to the Sierra and the Cascades are as follows: Of boreal species, including those which range down into the Transition zone, 87 percent; of species restricted to the Boreal zones, 85 percent; of species restricted to the Hudsonian and Alpine zones, 60 percent.

The percentages of Shasta mammals common to the Sierra and the Cascades are: Of boreal species, including those which range down into the Transition zone, 72 percent; of species restricted to the Boreal zones, 70 percent; of species restricted to the Hudsonian and Alpine zones, 67 percent.[1]

The percentages of Shasta plants common to the Sierra and the Cascades are: Of boreal species, including those which range down into the Transition zone, 49 percent; of species restricted to the Boreal zones, 46 percent; of species restricted to the Hudsonian and Alpine zones, 44 percent.

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[1] The number of Hudsonian-Alpine species is too small to give this percentage much value.

For evidence of another kind—that based on the *absence* from Shasta of species which occur in the Sierra or the Cascades or both—see pages 79–82.

Following are the tables on which the foregoing generalizations are based:

(1) BOREAL SPECIES COMMON TO SHASTA AND THE SIERRA-CASCADE SYSTEM.

(Species followed by the letter T range down into or through the Transition zone.)

(*a*) MAMMALS.

Callospermophilus chrysodeirus T.
Canis lestes.
Erethizon epixanthus T.?
Eutamias amœnus T.
Eutamias senex T.
Evotomys mazama.[1]
Felis oregonensis T.
Lepus klamathensis T.?
Lutreola vison energumenos T.
Microtus mordax T.
Mustela caurina.
Mustela pennanti.
Myotis lucifugus longicrus T.
Myotis yumanensis saturatus.
Neotoma cinerea T.
Neurotrichus gibbsi major T.
Ochotona schisticeps.
Odocoileus columbianus T.
Peromyscus gambeli T.
Phenacomys orophilus.
Putorius arizonensis.
Sorex vagrans amœnus T.
Sorex (Neosorex) navigator.
Taxidea taxus T.
Ursus americanus T.
Vulpes macrourus T.

(*b*) BIRDS.

Accipiter atricapillus striatulus.
Accipiter velox.
Aquila chrysaëtos T.
Carpodacus cassini.
Ceophlœus pileatus abieticola T.
Certhia familiaris occidentalis T.
Cinclus mexicanus T.?
Coccothraustes vespertinus montanus.
Colaptes cafer T.
Contopus borealis T.
Dendragapus obscurus fuliginosus T.
Dendroica auduboni T.
Dendroica occidentalis.
Dryobates villosus hyloscopus T.
Empidonax difficilis T.
Empidonax hammondi T.
Empidonax wrighti T.
Geothlypis tolmiei T.
Helminthophila celata lutescens T.
Helminthophila rubricapilla gutturalis T.
Hylocichla aonalaschkæ auduboni T.
Melospiza lincolni T.
Merula migratoria propinqua T.
Myadestes townsendi.
Nucifraga columbiana.
Oreortyx pictus plumiferus T.
Parus gambeli.
Picoides arcticus.
Piranga ludoviciana T.
Regulus calendula.
Regulus satrapa olivaceus.
Salpinctes obsoletus T.
Selasphorus rufus T.
Sialia arctica.
Sitta canadensis.
Sitta carolinensis aculeata T.
Sphyrapicus thyroideus.
Spinus pinus.
Stellula calliope T.
Wilsonia pusilla pileolata T.?
Zonotrichia leucophrys.

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[1] *Evotomys mazama*, a common Cascade species, was obtained by us on Shasta and Lassen, and doubtless occurs in the Sierra, farther south.

(c) PLANTS.

Achillea borealis.
Aconitum columbianum.
Allium validum.
Alnus sinuata.
Antennaria media.
Arabis platysperma.
Arctostaphylos nevadensis.
Bikukulla uniflora.
Cardamine bellidifolia pachyphylla.
Carex breweri.
Castanopsis sempervirens T.
Chimaphila menziesi T.
Chimaphila umbellata T.
Chrysothamnus bloomeri.
Cymopterus terebinthinus.
Drosera rotundifolia.
Epilobium obcordatum.
Epilobium pringleanum.
Eriogonum pyrolæfolium.
Gentiana simplex.
Habenaria leucostachys.
Habenaria unalaschensis.
Heracleum lanatum T.
Holodiscus discolor.
Hypericum anagalloides.
Juncus parryi.
Juniperus nana.
Kalmia glauca microphylla.
Mimulus primuloides.
Mitella pentandra.
Oreobroma triphylla.
Orthocarpus pilosus.
Oxyria digyna.
Pentstemon newberryi.
Phlox douglasi diffusa.
Pinus albicaulis.
Pinus monticola.
Pinus murrayana.
Polemonium pulchellum.
Polygonum shastense.
Potentilla flabellifolia.
Pulsatilla occidentalis.
Pyrola picta T.
Pyrola secunda T.
Ribes cereum T.
Sagina saginoides.
Salix nuttalli T.
Salix sitchensis T.
Saxifraga tolmiei.
Sibbaldia procumbens.
Sorbus sambucifolia T.
Spraguea umbellata.
Tsuga mertensiana.
Viola blanda.
Viola purpurea.

(2) BOREAL SPECIES COMMON TO SHASTA AND THE SIERRA BUT NOT KNOWN FROM THE CASCADES.

(a) MAMMALS.

Aplodontia major (represented in Cascades by A. major rainieri).
Ovis canadensis (not known or represented in Cascades).
Peromyscus boyli T. (not known or represented in Cascades).
Sciurus albolimbatus T. (represented in Cascades by S. cascadensis).
Sorex montereyensis T. (not known from any point north of Shasta).
Thomomys monticola (represented in Cascades by T. mazama).
Zapus trinotatus alleni (represented in Cascades by Z. montanus).

(b) BIRDS.

Cyanocitta stelleri frontalis T. (represented in Cascades by C. stelleri).[1]
Junco hyemalis thurberi (represented in Cascades by J. h. connectens).
Leucosticte tephrocotis[2] (represented in Cascades by L. t. littoralis).
Loxia curvirostra bendirei (represented in Cascades by L. c. minor).

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[1] The Shasta jay is intermediate between *stelleri* and *frontalis*.

[2] The mention of *Leucosticte tephrocotis* in this and subsequent lists involves an assumption. *L. tephrocotis* is known to be the breeding rosy finch of the High Sierra; *L. t. littoralis* that of Mount Rainier in the Cascades of Washington. A rosy finch was found, but not secured, on Shasta. It is referred provisionally to *tephrocotis* rather than *littoralis*, because the great majority of Shasta species which are not common to both ranges are Sierra and not Cascade forms.

BOREAL SPECIES OF SHASTA AND SIERRA—Continued.

(c) PLANTS.

Agoseris monticola.
Arnica merriami.
Castilleja affinis.
Castilleja miniata (alpine form).
Chænactis nevadensis.
Cheiranthus perennis.
Corallorhiza bigelovi.
Crepis intermedia.
Cycladenia humilis.
Delphinium sonnei.
Draba breweri.
Erigeron armeriæfolium.
Erigeron compositus trifidus.
Erigeron inornatus.
Eriogonum polypodum.
Hieracium albiflorum (alpine form).
Hieracium horridum.
Hulsea larseni.
Madia bolanderi.
Parnassia californica.
Pentstemon gracilentus.
Ribes amictum T.
Saxifraga bryophora.
Senecio canus.
Senecio trigonophyllus.
Stellaria crispa.
Streptanthus orbiculatus.
Vaccinium cæspitosum.
Vagnera stellata T.
Veratrum californicum T.

(3) BOREAL SPECIES COMMON TO SHASTA AND THE CASCADES BUT NOT KNOWN FROM THE SIERRA.

(a) MAMMALS.

Cervus occidentalis T.

(b) BIRDS.

Anthus pensilvanicus.
Perisoreus obscurus.

(c) PLANTS.

Abies shastensis.
Epilobium clavatum.
Hieracium gracile.
Hulsea nana.
Ligusticum grayi.
Lupinus lyalli.
Lupinus 'ornatus.'
Lutkea pectinata.
Machæranthera shastensis.
Oreastrum alpiginum.
Pentstemon menziesi.
Phyllodoce empetriformis.
Polygonum newberryi.
Silene suksdorfi.
Tofieldia occidentalis.
Vaccinium arbuscula T.
Veronica cusicki.

(4) BOREAL SHASTA SPECIES NOT KNOWN FROM EITHER THE SIERRA OR THE CASCADES.

(a) MAMMALS.

Perognathus mollipilosus T.
Sorex shastensis.

(b) BIRDS.

[None.]

(c) PLANTS.

Arnica longifolia.
Arnica viscosa.[1]
Campanula wilkinsiana.[1]
Mimulus implexus.
Pentstemon glaber utahensis.
Phacelia frigida.[1]
Scutellaria nana.
Silene grayi.[1]

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[1] So far as known restricted to Shasta.

(5) EXCLUSIVELY BOREAL SPECIES OF SHASTA.

(a) MAMMALS.

Aplodontia major.
Canis lestes.
Evotomys mazama.
? Lepus klamathensis.
Microtus mordax.
Mustela caurina.
Mustela pennanti.
Myotis yumanensis saturatus.
Ochotona schisticeps.
Ovis canadensis.
Phenacomys orophilus.
Putorius arizonensis.
Sorex (Neosorex) navigator.
Sorex shastensis.
Thomomys monticola.
Vulpes macrourus.
Zapus trinotatus alleni.

(b) BIRDS.

Accipiter atricapillus striatulus.
Anthus pensilvanicus.
Carpodacus cassini.
Cinclus mexicanus.
Coccothraustes vespertinus montanus.
Dendroica occidentalis.
Junco hyemalis thurberi.
Leucosticte tephrocotis.
Loxia curvirostra bendirei.
Myadestes townsendi.
Nucifraga columbiana.
Parus gambeli.
Perisoreus obscurus.
Picoides arcticus.
Regulus calendula.
Regulus satrapa olivaceus.
Sialia arctica.
Sitta canadensis.
Sphyrapicus thyroideus.
Spinus pinus.
Wilsonia pusilla pileolata.
Zonotrichia leucophrys.

(c) PLANTS.

Abies shastensis.
Achillea borealis.
Aconitum columbianum.
Agoseris monticola.
Allium validum.
Allium sp. ——?
Alnus sinuata.
Antennaria media.
Arabis platysperma.
Arctostaphylos nevadensis.
Arnica longifolia.
Arnica merriami.
Arnica viscosa.
Bikukulla uniflora.
Campanula wilkinsiana.
Cardamine bellidifolia pachyphylla.
Carex breweri.
Castilleja miniata (alpine form).
Chænactis nevadensis.
Cheiranthus perennis.
Chrysothamnus bloomeri.
Corallorhiza bigelovi.
Crepis intermedia.
Cycladenia humilis.
Cymopterus terebinthinus.
Delphinium sonnei.
Draba breweri.
Drosera rotundifolia.
Epilobium clavatum.
Epilobium obcordatum.
Epilobium pringleanum.
Erigeron armeriæfolium.
Erigeron compositus trifidus.
Erigeron inornatus.
Eriogonum polypodum.
Eriogonum pyrolæfolium.
Gentiana simplex.
Habenaria leucostachys.
Habenaria unalaschensis.
Hieracium albiflorum (alpine form).
Hieracium gracile.
Hieracium horridum.
Holodiscus discolor.
Hulsea larseni.
Hulsea nana.
Hypericum anagalloides.
Juncus parryi.
Juniperus nana.
Kalmia glauca microphylla.
Ligusticum grayi.
Lupinus albifrons.
Lupinus lyalli.
Lupinus 'ornatus.'
Lutkea pectinata.
Machæranthera shastensis.
Madia bolanderi.
Mimulus implexus.
Mimulus primuloides.

EXCLUSIVELY BOREAL SPECIES OF SHASTA—Continued.

(c) PLANTS—continued.

Mitella pentandra.
Monardella odoratissima.
Oreastrum alpiginum.
Oreobroma triphylla.
Orthocarpus pilosus.
Oxyria digyna.
Parnassia californica.
Pentstemon deustus.
Pentstemon glaber utahensis.
Pentstemon gracilentus.
Pentstemon menziesi.
Pentstemon newberryi.
Phacelia frigida.
Phlox douglasi diffusa.
Phyllodoce empetriformis.
Pinus albicaulis.
Pinus monticola.
Pinus murrayana.
Polemonium pulchellum.
Polygonum newberryi.
Polygonum shastense.
Potentilla flabellifolia.
Potentilla pseudorupestris.
Pulsatilla occidentalis.
Sagina saginoides.
Saxifraga bryophora.
Saxifraga tolmiei.
Senecio canus.
Senecio trigonophyllus.
Sibbaldia procumbens.
Silene grayi.
Silene suksdorfi.
Sitanion cinereum.
Spraguea umbellata.
Stellaria crispa.
Streptanthus orbiculatus.
Tofieldia occidentalis.
Tsuga mertensiana.
Vaccinium cæspitosum.
Vaccinium occidentale.
Veronica cusicki.
Viola blanda.
Viola purpurea.

(6) EXCLUSIVELY HUDSONIAN-ALPINE SPECIES OF SHASTA.

MAMMALS.

Ochotona schisticeps.
Ovis canadensis.
Phenacomys orophilus.

BIRDS.

Anthus pensilvanicus.
Leucosticte tephrocotis.
Nucifraga columbiana.
Sialia arctica.
Zonotrichia leucophrys.

PLANTS.

Achillea borealis.
Agoseris monticola.
Antennaria media.
Arabis platysperma.
Arnica merriami.
Arnica viscosa.
Bikukulla uniflora.
Cardamine bellidifolia pachyphylla.
Carex breweri.
Chænactis nevadensis.
Cheiranthus perennis.
Chrysothamnus bloomeri.
Cycladenia humilis.
Cymopterus terebinthinus.
Draba breweri.
Epilobium clavatum.
Epilobium obcordatum.
Epilobium pringleanum.
Erigeron armeriæfolium.
Erigeron compositus trifidus.
Eriogonum polypodum.
Eriogonum pyrolæfolium.
Hieracium albiflorum (alpine form).
Hieracium gracile.
Hieracium horridum.
Holodiscus discolor (alpine form).
Hulsea larseni.
Hulsea nana.
Juncus parryi.
Juniperus nana.
Kalmia glauca microphylla.
Lupinus albifrons.
Lupinus lyalli.
Lupinus 'ornatus.'
Lutkea pectinata.
Machæranthera shastensis.
Mimulus implexus.
Mitella pentandra.
Oreastrum alpiginum.
Oreobroma triphylla.

EXCLUSIVELY HUDSONIAN-ALPINE SPECIES OF SHASTA—Continued.

PLANTS—continued.

Orthocarpus pilosus.
Oxyria digyna.
Parnassia californica.
Pentstemon glaber utahensis.
Pentstemon menziesi.
Pentstemon newberryi.
Phacelia frigida.
Phyllodoce empetriformis.
Pinus albicaulis.
Polemonium pulchellum.
Polygonum newberryi.
Polygonum shastense.
Potentilla flabellifolia.
Potentilla pseudorupestris.
Pulsatilla occidentalis.
Sagina saginoides.
Saxifraga bryophora.
Saxifraga tolmiei.
Senecio canus.
Sibbaldia procumbens.
Silene grayi.
Silene suksdorfi.
Sitanion cinereum.
Streptanthus orbiculatus.
Tsuga mertensiana.
Vaccinium cæspitosum.
Veronica cusicki.
Viola purpurea.

(7) EXCLUSIVELY HUDSONIAN-ALPINE SPECIES COMMON TO SHASTA AND THE SIERRA-CASCADE SYSTEM.

MAMMALS.

Ochotona schisticeps.
Phenacomys orophilus.

BIRDS.

Nucifraga columbiana.
Sialia arctica.
Zonotrichia leucophrys.

PLANTS.

Achillea borealis.
Antennaria media.
Arabis platysperma.
Bikukulla uniflora.
Cardamine bellidifolia pachyphylla.
Carex breweri.
Chrysothamnus bloomeri.
Cymopterus terebinthinus.
Epilobium obcordatum.
Epilobium pringleanum.
Eriogonum pyrolæfolium.
Holodiscus discolor (typical alpine form).
Juncus parryi.
Juniperus nana.
Kalmia glauca microphylla.
Mitella pentandra.
Oreobroma triphylla.
Orthocarpus pilosus.
Oxyria digyna.
Pentstemon newberryi.
Pinus albicaulis.
Polemonium pulchellum.
Polygonum shastense.
Potentilla flabellifolia.
Pulsatilla occidentalis.
Sagina saginoides.
Saxifraga tolmiei.
Sibbaldia procumbens.
Tsuga mertensiana.
Viola purpurea.

(8) EXCLUSIVELY HUDSONIAN-ALPINE SPECIES COMMON TO SHASTA AND THE SIERRA BUT NOT KNOWN FROM THE CASCADES.

MAMMALS.

Ovis canadensis.

BIRDS.

? Leucosticte tephrocotis.

PLANTS.

Agoseris monticola.
Arnica merriami.
Chænactis nevadensis.
Cheiranthus perennis.
Cycladenia humilis.
Draba breweri.
Erigeron armeriæfolium.
Erigeron compositus trifidus.

HUDSONIAN-ALPINE SPECIES OF SHASTA AND SIERRA—Continued.

PLANTS—continued.

Eriogonum polypodum.
Hieracium albiflorum (alpine form).
Hieracium horridum.
Hulsea larseni.
Parnassia californica.
Saxifraga bryophora.
Senecio canus.
Streptanthus orbiculatus.
Vaccinium cæspitosum.

(9) EXCLUSIVELY HUDSONIAN-ALPINE SPECIES COMMON TO SHASTA AND THE CASCADES BUT NOT KNOWN FROM THE SIERRA.

MAMMALS.

None.

BIRDS.

Anthus pensilvanicus.

PLANTS.

Epilobium clavatum.
Hieracium gracile.
Hulsea nana.
Lupinus lyalli.
Lupinus 'ornatus.'
Lutkea pectinata.
Machæranthera shastensis.
Oreastrum alpiginum.
Pentstemon menziesi.
Phyllodoce empetriformis.
Polygonum newberryi.
Silene suksdorfi.
Veronica cusicki.

BOREAL SPECIES OF THE SIERRA-CASCADES NOT KNOWN FROM SHASTA.

Turning to another phase of the subject, the *absentees*, or boreal species of the Sierra and Cascades which are not known from Shasta, an equally instructive lesson may be learned.

The boreal species that occur in the Sierra or Cascades, or both, but which are not known from Shasta, have been grouped in three categories: (1) species common to the Sierra-Cascades but not known from Shasta; (2) Sierra species not known from Shasta or the Cascades; and (3) Cascade species not known from Shasta or the Sierra.[1]

(1) BOREAL SPECIES COMMON TO THE SIERRA AND THE CASCADES BUT NOT KNOWN FROM SHASTA.

Only three boreal mammals are known to occur in both the Sierra and the Cascades which have not been found on Shasta. These are the Sierra marmot (*Arctomys flaviventer*), the wolverine (*Gulo luscus*), and the silver-haired bat (*Lasionycteris noctivagans*). The marmot, it may be stated with confidence, is really absent; the wolverine has been killed in the near vicinity and probably occurs on Shasta; the bat is a local species common in the mountains west of Shasta, easily overlooked and most likely to occur. Hence there is every reason to believe that the Sierra marmot is really the only mammal common to the Sierra and the Cascades which does not occur on Shasta.

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[1] In the accompanying tables and discussion the boreal species are treated collectively, no account being taken of the important distinctions between the Alpine, Hudsonian, and Canadian species. This course has been rendered necessary by the absence of discriminative zone lists of Cascade-Sierra species.

Two boreal birds believed to be common to the Sierra-Cascade system (the western winter wren, *Anorthura hiemalis pacifica*, and the Townsend warbler, *Dendroica townsendi*) have not yet been discovered on Shasta, but are liable to be found there at any time.

With plants the case is quite different, for at least 19 well-known genera, and a considerable number of species of other genera, not known from Shasta are common to the Sierra and the Cascades.

(a) MAMMALS.

Arctomys flaviventer.
Gulo luscus.
Lasionycteris noctivagans.

(b) BIRDS.

Anorthura hiemalis pacifica.
Dendroica townsendi.

(c) PLANTS.

Genera not known from Shasta.

Arenaria.
Cassiope.
Claytonia.
Clintonia.
Erythronium.
Geum.
Heuchera.
Iris.
Ivesia.
Listera.
Mertensia.
Pedicularis.
Primula.
Raillardella.
Ranunculus.
Smelowskia.
Streptopus.
Thalictrum.
Xerophyllum.

Additional species not known from Shasta.

Arnica chamissonis.
Campanula sconleri.
Crepis nana.
Erigeron salsuginosus.
Gentiana newberryi.
Juncus orthophyllus.
Lonicera conjugalis.
Lonicera involucrata.
Polygonum bistortoides.
Populus tremuloides.
Salix barclayi.
Saxifraga nivalis.
Saxifraga punctata.

(2) BOREAL SIERRA SPECIES NOT KNOWN FROM SHASTA OR THE CASCADES.

Eight mammals, 1 bird, 3 coniferous trees, several shrubs, and a number of small plants are known from the High Sierra which do not occur on Shasta or the Cascades; the majority of them are restricted to the southern part of the Sierra, not reaching as far north as the mountains about Lake Tahoe, and consequently need not be considered here. Only three of the Sierra mammals (*Spermophilus beldingi*, *Eutamias speciosus frater*, and *Sorex obscurus*) which range north to the south end of Feather River Gap fail to reach Shasta, and two if not all three of these are known to cross this gap and occur on Lassen, showing that the Feather River Gap of itself is of very little significance. The details of plant distribution in these mountains are not sufficiently known to admit of safe generalizations.

BOREAL SIERRA SPECIES—Continued.

(*a*) MAMMALS.

Eutamias alpinus.[1]
Eutamias speciosus.[1]
Eutamias speciosus callipeplus.[1]
Eutamias speciosus frater.
Microtus dutcheri.[1]
Sorex obscurus.
Spermophilus beldingi.
Thomomys alpinus.[1]

(*b*) BIRDS.

Pinicola enucleator californica.

(*c*) PLANTS.

Abies magnifica.
Arenaria compacta.
Arenaria congesta.
Artemisia rothrocki.
Chrysopsis breweri.
Draba lemmoni.
Eulophus parishi.
Hulsea algida.
? Ledum glandulosum.
Leucothoe davisiæ.
Lychnis californica.
Montia fontana.
Oreobroma nevadensis.
Oreobroma pygmæa.
Phyllodoce breweri.
Pinus balfouriana.
Pinus flexilis.
Primula suffrutescens.
Quercus vaccinifolia.
Raillardella scaposa.
Ranunculus oxynotus.
Silene bernardina.
Silene californica.

(3) BOREAL CASCADE SPECIES NOT KNOWN FROM SHASTA OR THE SIERRA.

Eleven mammals, 2 birds, 3 fir trees, and a number of shrubs and other plants which inhabit the Cascade Range in Oregon are not known to occur on Shasta or in the Sierra Nevada. One of the mammals (*Eutamias townsendi*) does not reach as far south as the southern end of the Cascades, and two others (*Aplodontia major rainieri* and *Sciurus cascadensis*) are only subspecifically separable from corresponding forms in the Sierra. The remaining eight are independent specific types not represented on Shasta or in the Sierra, and all of them push south to the extreme southern end of the Cascades immediately across Klamath Gap from Shasta.

(*a*) MAMMALS.

Aplodontia major rainieri.
Eutamias townsendi.
Lynx canadensis.
Microtus (Arvicola) arvicoloides.
Microtus (Chilotus) bairdi.
Putorius cicognani streatori.
Scapanus alpinus.
Sciurus douglasi cascadensis.
Sorex (Atophyrax) bendirei.
Thomomys mazama.
Zapus montanus.

(*b*) BIRDS.

Hylocichla ustulata.
Leucosticte tephrocotis littoralis.[2]

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[1] These mammals are restricted to the southern part of the Sierra and none of them come as far north as the mountains about Lake Tahoe.

[2] *Leucosticte tephrocotis littoralis* breeds in the Cascades of Washington but is not actually known from the Cascades of Oregon. It is likely to be found among the glaciers of Mount Hood and The Sisters when the birds of these mountains are studied.

(c) PLANTS.

Abies amabilis.
Abies lasiocarpa.
Abies nobilis.
Gaultheria myrsinites.
Menziesia ferruginea.
Rhododendron albiflorum.
Ribes erythrocarpum.
Ribes lacustre.
Rubus lasiococcus.
Silene acaulis.
Sorbus occidentalis.
Spiræa arbuscula.
Vaccinium microphyllum.
Valeriana sitchensis.

EFFICIENCY OF KLAMATH GAP AS A BARRIER TO BOREAL SPECIES COMPARED WITH THAT OF PITT RIVER AND FEATHER RIVER GAPS COLLECTIVELY.

In view of the narrowness of Klamath Gap, a break of less than 50 miles, separating the boreal fauna of Shasta from that of the Cascades, compared with the breadth of the combined Pitt River and Feather River gaps, about 100 miles, separating Shasta from the boreal fauna of the Sierra Nevada northwest of Honey Lake, one might expect Shasta to share more species with the Cascades than with the Sierra. The contrary is true. The Feather River Gap, as elsewhere explained (p. 70), is ineffective compared with the others; the branches of Feather River do not cut completely through the mountains, and the gap is merely a low part of the range, with the Honey Lake ridge and small boreal-capped peaks projecting here and there as stepping stones between the main Sierra and Mount Lassen. Pitt River Gap is deeper, cutting completely through the range between Lassen and Shasta, forming a boreal break about 60 miles in width, and there is no apparent reason why it should not be as effective a barrier as Klamath Gap, although from the standpoint of zone distribution it does not cut so low and therefore has a slightly cooler summer climate, in consequence of which it is less effective. But this difference is insufficient to explain the really great disparity in potency of the two, for in checking the extension of boreal species Klamath Gap has proved far more effective.

Passing over the species common to Shasta and the Sierra-Cascade system as a whole (see p. 73), only three of the ten distinctively Sierra mammals which reach the northern end of the Sierra fail to reach Shasta, and two if not all of these bridge the Feather River Gap and reach Mount Lassen, which is separated from Shasta by only the Pitt River Gap. On the other hand, *not one of the ten* distinctively Cascade mammals which occur at the extreme south end of the Cascade Range has been able to cross the narrow Klamath Gap to Shasta.

If the number of distinctive mammals of the Sierra-Cascade system be reduced by subtracting those which are represented in the two ranges by closely related forms[1] 8 distinctive specific types will remain for the southern Cascades and 7 for the northern Sierra. Of these distinctive specific types only 3 of the 7 Sierra species fail to reach Shasta, while all of the 8 Cascade species fail.

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[1] Close discrimination of species and subspecies is necessary in laying off the minor subdivisions of faunas; and it is interesting from the zoological standpoint to know which and how many of the specific types common to a given area have undergone enough change in parts of that area to warrant separate recognition by name, but from the standpoint of the distribution of specific types such details are of little value.

The significance of these facts appears when the Boreal faunas of the mountains north and south of Klamath Gap are studied with reference to their geographic sources of origin, as pointed out in the next chapter.

SOURCES OF THE BOREAL FAUNAS OF SHASTA AND OF THE SIERRA AND THE CASCADES.

The boreal animals and plants of the Sierra-Cascade system as a whole are not yet well enough known to admit of positive statements as to the number of species or the details of their distribution. Hence a complete study of their distribution with reference to the geographic source of origin of the various specific types is not possible. Nevertheless, enough has been learned to point to some very interesting conclusions.

It has been already shown that the boreal fauna and flora of Shasta form a part of the fauna and flora of the Sierra-Cascade system; that 70 percent of the exclusively boreal mammals of Shasta are common to both ranges; and that of the remainder, 80 percent are common to the Sierra. It is obvious therefore that, so far as mammals are concerned, Shasta may be considered a part of the Sierra (see p. 71).

Fifty-eight boreal[1] species of mammals are known from the Sierra and the Cascades. Of these, 31 (54 percent) are common to both ranges, 11 (19 percent) are restricted to the Sierra, and 16 (28 percent) to the Cascades.

Of the 58 boreal species of mammals known to inhabit the Sierra-Cascade system not a single genus or subgenus is peculiar, though the genera *Aplodontia* and *Neurotrichus* and the subgenus *Atophyrax* are restricted to the northwest coast region. With species the case is very different, for 23 of the 58 species (40 percent) are peculiar to the Sierra-Cascades; but even of these only 10 differ sufficiently from near relatives elsewhere to be considered distinct specific types. Of the 58 species whose relationships are so obvious that there can be no doubt as to their affinities and origin, 5 (9 percent) come from mountains farther north (in British Columbia, some ranging into southeastern Alaska), 8 (14 percent) are of general transcontinental boreal distribution, 16 (28 percent) are characteristic of the humid west or northwest coast region, 19 (33 percent) are identical with or closely related to species living in the Rocky Mountains, and 10 (17 percent) are distinctive superspecific types restricted to the Sierra-Cascade system.

If, instead of treating the Sierra-Cascade species collectively, we group them with reference to the particular part of the mountains they inhabit, putting the Cascade species (those north of Klamath Gap) in one category, and the Sierra species (those south of Klamath Gap) in another, some additional facts are brought out which emphasize the widely different sources of origin of the distinctively Cascade species on the one hand, and the distinctively Sierra species on the other. Of the distinctively Cascade species, 25 percent are derived from mountains farther north, 12 percent are local types, 12 percent belong to transcontinental boreal types, and 25 percent to northwest-coast types. Of the distinctively Sierra species, 50 percent are specially developed local types, and 50 percent belong to types common to the Sierra and the southern Rocky Mountains.

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[1] Our collections from the Cascades have not yet been worked up, and it is probable that several species will be added to this number.

These facts point not only to the great antiquity and effectiveness of the Klamath Gap, but also to a former east and west continuity of range of Boreal species between the Rocky Mountains of Utah and Colorado and the Sierra Nevada of California, a distance of at least 500 miles.

Sorex shastensis sp. nov. Shasta Shrew.

Type from Wagon Camp, Mount Shasta (alt. 5,700 ft. in the lower part of the Canadian zone). No. 95450, U. S. Nat. Mus., Biological Survey Coll. Collected Sept. 26, 1898, by W. H. Osgood. Orig. No. 317.

Characters.—Size small; decidedly smaller than *S. vagrans;* tail rather short; ears small, but conspicuous. Third unicuspid smaller than fourth. Skull and teeth peculiar.

Color.—Type specimen, in change from summer to winter pelage: Head and sides of neck to shoulders dull fulvous brown; rest of upper parts dark steel gray; underparts ashy brown; tail sharply bicolor, dusky above, buffy below, becoming dusky toward tip.

Cranial characters.—Skull small, decidedly smaller than in *vagrans* and as small as in *californicus;* brain case moderately high—not at all flattened as in *californicus;* rostrum rather small (about as in *californicus*); constriction swollen. Tooth row, as a whole, somewhat shorter than in *californicus;* unicuspids decidedly narrower, particularly the first and second; molariform series much as in *californicus*, but slightly smaller; large premolar very broad posteriorly.

Measurements.—Type: Total length, 90; tail vertebræ, 35; hind foot, 12.

Remarks.—This new species is based on a single specimen caught by W. H. Osgood in a trap set in a springy place among the Shasta firs, immediately above Wagon Camp. In the same trap, and in the identical spot, he caught also specimens of *Neosorex navigator* and *Neurotrichus gibbsi major.* Several specimens of *Sorex vagrans amœnus* were caught near by, but no others of this species.

Sorex shastensis is a small shrew of uncertain affinities. In several respects it resembles *S. californicus*, but differs from this species markedly in color, and still more in the form of the cranium and narrowness of the unicuspidate teeth.

Sorex vagrans amœnus Merriam. Sierra Shrew.

Twenty-two specimens of this small shrew were collected on Shasta and about its base. Two were caught among the tules at Big Spring, in Shasta Valley, on the north side of the mountain; two at Warmcastle Soda Springs, in Squaw Creek Valley, on the south side; and nineteen in the Canadian zone and lower part of the Hudsonian from Wagon Camp up to upper Squaw Creek, Mud Creek, and Ash Creek. Most of them were trapped under logs in damp places.

Sorex montereyensis Merriam. Monterey Shrew.

Six specimens of this large long-tail shrew were secured—one at the lower edge of the Hudsonian zone, near Mud Creek; four in the Canadian zone, in Mud Creek Canyon; and one in the Transition zone, in Squaw Creek Valley, near Warmcastle Soda Springs.

Sorex (Neosorex) navigator Baird. White-bellied Water-shrew.

Apparently rather scarce, as a large amount of trapping resulted in the capture of only four specimens. These were obtained at as many localities, namely, the head of Panther Creek, upper Squaw Creek, upper Ash Creek Canyon, and Wagon Camp, all in the Canadian zone.

Neurotrichus gibbsi major subsp. nov. Large Shrewmole.

Type from Carberry Ranch, Shasta County, Calif. (alt. 4,100 ft., between Mts. Shasta and Lassen). No. 65321, ♂ ad., U. S. Nat. Mus., Biological Survey Coll. Collected May 18, 1894, by C. P. Streator. Orig. No. 3789.

Characters.—Similar to *N. gibbsi*, but decidedly larger; hind feet larger; forefeet much broader and longer; tail much longer; under parts darker; skull larger and broader; fifth upper lateral tooth (the 'large premolar') decidedly *smaller* than in *N. gibbsi*, and possessing a distinct anterior cusp on the cingulum, which is absent in *gibbsi;* fifth lower lateral tooth (the 'large premolar') decidedly *larger* than in *gibbsi*.

Measurements.—Average of 3 specimens from type locality: Total length, 120; tail vertebræ, 40; hind foot, 17. Average of 4 specimens from Mount Shasta: Total length, 113; tail vertebræ, 41; hind foot, 16.2.

Remarks.—Four specimens of this new form of Gibbs shrewmole were collected by our party on Shasta—all in the Canadian zone. Three were caught in Mud Creek canyon near the mouth of Clear Creek by Walter K. Fisher and W. H. Osgood, and one was taken at Wagon Camp by Osgood. In May, 1894, my assistant, Clark P. Streator, obtained 3 specimens (the type and cotypes) at Carberry Ranch, on the south side of Pitt River, between Mounts Shasta and Lassen. Carberry Ranch is in the upper part of the Transition zone. The Canadian zone specimens from Shasta are not quite so large, but agree in other characters.

Scapanus californicus (Ayres). California Mole.

Vernon Bailey found a dead mole of this species, October 3, in the road between Wagon Camp and Sisson at an altitude of 4,500 feet. He reported mole ridges as common in places a little below Wagon Camp, and also in sandy soil in the Murray pine belt east of the mountain; W. H. Osgood saw mole ridges in Shasta Valley.

Myotis evotis (H. Allen.) Big-eared Bat.

At Sisson, September 5, R. T. Fisher obtained a specimen from a small boy, who caught it in a kitchen. The species doubtless occurs in Shasta Valley also.

Myotis lucifugus longicrus (True).

At Wagon Camp, July 17, Walter K. Fisher shot one of these bats. Small bats were abundant here, but kept so much in the forest that they were hard to shoot.

Myotis californicus (Aud. & Bach.). California Bat.

A single specimen of this species, collected on Mount Shasta by C. H. Townsend, is recorded by Miller in North American Fauna, No. 13, page 71, October, 1897.

Myotis yumanensis saturatus Miller.

Common among the alpine hemlocks at Squaw Creek Camp, where they were seen every night, darting in and out of the flickering light of the camp fire. Here I shot one the evening of August 3, and four the evening of August 9. Late in July and early in August small bats, probably the same species, were seen nearly every evening at the temporary camps on or near upper Mud Creek. The species is interesting as the only bat secured in the Hudsonian zone.

Vespertilio fuscus Beauvois. Large Brown Bat.

Common at Wagon Camp, where Vernon Bailey shot one July 17, and I shot three the evening of July 28. Many more could have been killed if desired. In 1883 C. H. Townsend obtained it at Sheep Rock. The species is one of the commonest in the foothills and valleys, and is easily recognized on the wing by its large size and its character of flight.

[**Arctomys flaviventer** (Aud. & Bach.). Mountain Marmot.

It may be asserted with confidence that no marmots of any kind live on Shasta. Our collectors were at work on the mountain from July 15 until October without seeing a single individual. Moreover, when Vernon Bailey and I made our trip completely around the peak the latter part of July we kept near timberline all the way and made a special search for marmots, but were unable to find a trace of their presence.]

Spermophilus douglasi (Richardson). Oregon Ground Squirrel.

Common at Sisson and in McCloud and Shasta valleys, whence it ranges up through the manzanita chaparral of the basal slopes nearly to Wagon Camp. At Sisson R. T. Fisher collected eight during the first half of September, and says of them: "One of the few really plentiful mammals at Sisson. Hardly an acre in the valley is free from their burrows. Under the barns and houses, in the fields, along the hot slopes east and west of the town, and even in the woods, one constantly sees them. At the time I write of, September 1–15, they seemed to be feeding chiefly on acorns and chinquapins—acorns in the valley, chinquapins on the western slopes. In behavior they were wild and sneaking; at all times difficult to approach. None appeared to have hibernated."

At Big Spring, in Shasta Valley, where they abound, W. H. Osgood saw several climb up on a beam and enter an opening in a granary.

Callospermophilus chrysodeirus Merriam. Golden-mantled Ground Squirrel.

One of the most abundant and conspicuous mammals of the mountain, where they were seen daily from the manzanita belt up to timberline, and where 52 specimens were collected. At Sisson they are rare, but 2,000 feet higher are fairly common, as they are also in Squaw Creek Valley at the south base of the mountain. In the fir forest they make their homes under logs or about the roots of trees, but in the neighborhood of timberline live in burrows under the rocks, often in slide rock, associated with small colonies of conies. At low altitudes they are usually unwary and may be easily killed with the 'auxiliary' barrel, but in the neighborhood of timberline they are so exceedingly shy it is difficult to approach within gunshot. At our camp among the alpine hemlocks on upper Squaw Creek they first kept at long range, but finding us harmless gradually overcame their fear, and finally, toward the end of the season, came to be one of the most persistent of camp robbers, stealing bread and other eatables. At the same time they never came freely and boldly as did their associates, the chipmunks, but always stole in silently and if possible kept out of sight.

This species goes into winter quarters much later than its relatives in the Rocky Mountain region. On Shasta it was seen daily near timberline until after the middle of September and a few were noticed on warm days as late as September 24, but all those secured during the latter part of the month were young of the year. Between Wagon Camp and Sisson they were seen as late as September 26.

Eutamias amœnus (Allen). Klamath Chipmunk.

Abundant in the chaparral of the lower slopes and thence up through the forest to timberline. Fifty-three specimens were obtained at various points on the mountain. At Wagon Camp they were common and were seen picking unripe serviceberries the latter part of July. At the south base of the mountain one was killed as low down as Warmcastle Soda Springs in Squaw Creek Valley. In the forest they live mostly about logs and stumps and are quite fearless, but along the upper edge of timber, where they live among the bare rocks, they are much more wary.

Eutamias senex (Allen). Allen Chipmunk.

Abundant in the Shasta fir belt and ranging down to Sisson and Warmcastle Soda Springs at the base of the mountain and up to the upper limit of continuous timber, though perhaps not to extreme timberline. Sixty-eight specimens were secured.

At Wagon Camp they were common and were usually associated with their small cousin, *E. amœnus*. They are more arboreal than the other chipmunks and we often saw them in the trees 40 or 50 feet above the ground, moving about in the branches or chasing one another around the great trunks of the hemlocks and firs. At our camp in the alpine hemlocks on Squaw Creek they were the most abundant and most fearless of the diurnal mammals. Here they were constantly associated with the less abundant golden-mantled ground squirrels (*Callospermophilus chrysodeirus*), compared with which they are bolder, more active, more graceful, and more interesting.

In camp they made frequent visits to the mess box, which they clearly regarded as public property, approaching it boldly and without suspicion and showing no concern at our presence—in marked contrast to the golden-mantled ground squirrels, which approached silently, stealthily, and by a circuitous route, in constant fear of detection. If disturbed while stuffing their cheek pouches with bits of bread, pancake, or other eatables, each chipmunk usually seized a large piece in its mouth and scampered off, returning as soon as we withdrew. In fact, they made themselves perfectly at home in camp, and evidently ranked us with other harmless inhabitants of the forest. They climbed up the sides of our tent and over towels hung to dry on branches, as if such things had always been a part of their environment. It should be added, however, that the most familiar animals were always the young of the year, which probably had no recollection of the time before our arrival.

Along the upper border of the timber, where the ground is more open and is covered with gray rocks and pumice instead of the dark felting of hemlock and fir needles and cones, the chipmunks are far more alert and wary.

After the middle of September the adults were rarely seen, and after the 20th the young came out only during the warmest part of the day.

At Sisson, R. T. Fisher found these chipmunks more abundant than any other mammal. They were common in the woods, in the chaparral, on the hillsides, and in the bottom of the valley. At the time of his visit—from the end of August to the middle of September—they were in the molt and very ragged.

Sciurus albolimbatus Allen. Sierra Pine Squirrel.

[=*S. californicus* Allen, preoccupied.]

Common in the Canadian zone forest of Shasta firs, and in the Transition forest of mixed pine and Douglas spruce. Among the Shasta firs they were seen on all sides of the mountain and came up as high as the lower edge of the alpine hemlocks. Among the pines and Douglas firs they were seen as low as Bear Butte, near Squaw Creek Valley, and were common at Sisson and thence northward along the base of the Scott Mountains. Like other pine squirrels they lay up stores of cones for winter use. At low elevations they rival the large gray tree squirrels in collecting the seeds of the huge cones of the sugar pines. At higher elevations they seem to feed largely on the much smaller seeds of the Shasta firs, the cones of which they collect in large numbers. These cones are gathered in heaps at the bases of trees, where the squirrels live, and are also stored in decayed logs, where they are stuffed into all available openings. As 1898, the year of our visit, was an 'off year' for cones, we were forced, in order to obtain specimens, to take advantage of the stores made by these squirrels the previous year. In them we found innumerable cones, more or less perfect and with the seeds still untouched, of both *Abies shastensis* and *A. lowiana*.

Sciurus fossor Peale. Oregon Gray Squirrel; Large Tree Squirrel.

Fairly common in the pine forest covering the southern and western basal slopes of Shasta. At different times during the summer these large squirrels were seen in Squaw Creek Valley and between Sisson and Edgewood. On July 13 Vernon Bailey found them common near Bear Creek, between Fall River Valley and Shasta, where the sugar pines begin. They were then cutting off the scales and eating the green seeds of the half-grown cones of sugar pines.

Sciuropterus alpinus klamathensis Merriam. Klamath Flying Squirrel.

The only flying squirrel seen by our party was observed by me in August on a cedar stub near a small stream a couple of miles below Wagon Camp, but was not secured. There is therefore some uncertainty as to the species. At Sisson I was informed that a boy had a pair alive in a cage, but he left town with them before they could be examined.

Castor canadensis Kuhl. Beaver.

Probably not now living in the immediate vicinity of Shasta, although in 1883, according to C. H. Townsend, "a number of them occupied unmolested a dam, which they had constructed in a corner of a meadow belonging to Mr. J. H. Sisson." They were formerly common in Shasta River, where Walter K. Fisher was recently told a few were seen in the winter of 1898–99.

Aplodontia major Merriam. Aplodontia; Sewellel.

In making the circuit of Shasta the latter part of July, Vernon Bailey and I discovered a colony of aplodontias in some rank vegetation covering a springy place in Ash Creek Canyon, in the upper part of the Canadian zone. A little later W. K. and R. T. Fisher were sent there and obtained two specimens. About the same time they and W. H. Osgood caught eight in Mud Creek Canyon near the mouth of Clear Creek, at an altitude of nearly 7,000 feet.

Aplodontias live in wet or damp places usually overgrown with rank vegetation, and preferably in springy, sloping ground where some of their innumerable burrows and sunken runways are kept wet by the cold trickling water. As is well known, they cut various plants, commonly rank or woody kinds, which they gather and carry in bundles to their burrows, or to places near by, where they spread them out to dry.

In Ash Creek Canyon Walter Fisher found their cuttings to consist chiefly of ferns and willows—the latter carried from a long distance. In Mud Creek Canyon the cuttings consisted chiefly, according to W. H. Osgood, of thimble-berry bushes, mountain ash, and brake ferns—the latter predominating, and in one place forming a pile as big as a bushel basket. The animals commonly live in colonies, but Osgood concluded that in Mud Creek Canyon only one individual, or at most a pair, lived in one place, "though several may be distributed among the branches of a stream."

Mus musculus Linn. House Mouse.

Abundant at Sisson, and running wild like the native species. R. T. Fisher reported them as constantly getting into his traps, particularly in the weeds and sedges in wet places along the banks of Cold Creek, where he caught a dozen or more.

Reithrodontomys klamathensis sp. nov.

Type from Big Spring ('Mayten'), Shasta Valley, Calif. No. 95444, ♂ ad., U. S. Nat. Mus., Biological Survey Coll. Collected Sept. 18, 1898, by W. H. Osgood. Orig. No. 281.

Characters.—Size medium; ears and hind feet large; tail long, only slightly shorter than in *longicauda;* color grayish or brownish gray, decidedly paler than *longicauda.*

Color.—Summer pelage: Upperparts pale grayish brown, washed with buffy on sides; underparts white, tail bicolor, dusky above, whitish below.

Cranial characters.—Skull rather large; braincase and rostrum relatively broad; audital bullæ small. The skull as a whole agrees better with that of *megalotis* than with that of *longicauda*, particularly in the length of palate and breadth of braincase; but the rostrum is broader and the audital bullæ are smaller than in either.

Measurements.—Type: Total length, 149; tail vertebræ, 71; hind foot, 19. Average of 2 adults from type locality: Total length, 144; tail vertebræ, 66; hind foot, 18.5.

Remarks.—Both in color and cranial characters *Reithrodontomys klamathensis* resembles the pale grayish *R. megalotis* of the desert region of the southern part of the Great Basin much more closely than it does the dark brownish *R. longicauda* of California west of the Sierra.

This new harvest mouse is common in wet places in Shasta and Little Shasta valleys, where four specimens were obtained by W. H. Osgood and R. T. Fisher. They were caught in little runways in wet grass near tules. The species doubtless reached Shasta Valley by way of the open Klamath country. During our explorations in eastern Oregon in 1896, numerous specimens of the same species were caught by my assistants, E. A. Preble and Cleveland Allen, in the tule marshes bordering the streams connecting Malheur and Harney lakes.

Peromyscus gambeli (Baird). Common White-footed Mouse.

Common on all, or nearly all, parts of the mountain from Sisson up to and possibly a little above extreme timberline. One hundred specimens were collected.

In choosing their homes these mice are easily suited, for they seem equally contented among the dense vegetation in damp parts of the bottoms of canyons ~~and among the bare lava~~ rocks and pumice soil of the driest timberline slopes. Some were caught also in the heather meadows bordering the little streams in the Hudsonian zone. At Sisson R. T. Fisher found them rather rare except in damp woods along Cold Creek, where he caught a number under roots and stumps close to the water.

Peromyscus boyli (Baird).

Exceedingly rare, or else of such peculiar habits that it escaped observation. Only a single specimen was obtained on Shasta. It was caught at the extreme upper limit of the Canadian zone (alt. 7,800 feet) on Squaw Creek, August 9, by Walter K. Fisher. Others were secured at Fall River Lake, in the Transition zone, southeast of the base of the mountain.

Peromyscus truei (Shf.). Big-eared Mouse.

Collected in Little Shasta Valley by Walter K. Fisher, who found it living among bushes of *Ceanothus cuneatus.*

Neotoma fuscipes Baird. Round-tail Wood Rat.

Not found on Shasta, but common in some of the low valleys at its base. Their characteristic stick houses were seen in the juniper forest at the southern end of Shasta Valley, in the chaparral near Gazelle, and in several places in the Scott Mountains (Bailey). In Little Shasta Valley one was collected September 19 (Osgood).

Neotoma cinerea Ord. Bushy-tail Wood Rat.

Rather scarce. Only four specimens were obtained—two in Mud Creek Canyon near the mouth of Clear Creek, and two high up on Squaw Creek (alt. 8,800 feet). Of those caught in Mud Creek Canyon, one was trapped at the end of an old log, the other at the entrance to an aplodontia burrow. Shasta abounds in the kinds of ledges and cliffs usually inhabited by this species, but, except at rare intervals, no traces of the animals were found.

Microtus californicus (Peale). California Vole.

Not obtained by us except in Shasta Valley, where six specimens were secured in September by W. H. Osgood and R. T. Fisher. Their runways were found in very wet places in the tules at Big Spring, in Shasta Valley, and along Little Shasta Creek. Walter K. Fisher secured specimens along Shasta River, northeast of Edgewood.

Microtus montanus (Peale).

Not obtained on Shasta, but collected at Fall River Lake in August by W. K. Fisher. In August, 1883, seven specimens were collected in the grassy meadows at Sisson Tavern by C. H. Townsend.

Microtus mordax (Merriam). Mountain Vole.

Common in suitable moist places throughout the Canadian and Hudsonian zones, particularly in the heather meadows a little below timberline, where, though chiefly nocturnal, they were sometimes seen in the daytime. Their burrows abound in the heather beds, especially along the overhanging banks of streams, and are so large that some of them were at first mistaken for those of *Microtus arvicoloides*, a species which does not occur on Shasta. They were not found in the dry forest. Seventy-four specimens were collected, of which only six were obtained at Wagon Camp. Near Sisson Tavern R. T. Fisher caught fifteen along "the wet and bushy banks of a long ditch." They probably reach Sisson not from Shasta, but from Mount Eddy, in the Scott Mountains, near the foot of which Sisson Tavern is situated. Still, it is possible that the two colonies are connected along some of the few cold streams that traverse the Transition zone slopes of Shasta.

Evotomys mazama Merriam. Mountain Evotomys.

Fairly common in moist places in the Shasta fir forests of the Canadian zone, where nineteen specimens were obtained. Ten were collected in Mud Creek Canyon near the mouth of Clear Creek (altitude 6,700 feet); seven along Squaw Creek from 6,700 up to 7,700 feet; one at the head of Panther Creek at 7,700 feet, and one at Wagon Camp at 5,700 feet. They were usually caught in traps set under logs in damp or wet places.

Phenacomys orophilus Merriam. Lemming-Mouse.

Rare and local, judging from the results of our trapping. Only three specimens were obtained—all in the heather meadows along the upper part of Squaw Creek, where they were caught August 7, 10, and 12 by Walter K. Fisher.

Thomomys monticola Allen. Sierra Pocket Gopher.

Abundant throughout the boreal slopes of the mountain, from the lower part of the Canadian zone to above timberline. In the dark forests of Shasta firs their mounds were seen wherever there was enough small vegetation to furnish food, and were commonest along the streams and about the edges of marshy places, where plant life is abundant and luxuriant. Above the line of continuous timber their mounds were noticed on many of the pumice slopes between the altitudes of 8,000 and 9,000 feet. Above the head of Squaw Creek a small colony was found at an altitude of 8,300 feet, and another between 8,900 and 9,000 feet. On the east side of Mud Creek Canyon they were seen at 8,800 feet, and on the west side at 8,900 feet. On our trip around the mountain near timberline, the latter part of July, their mounds were found in almost every place where the soil was deep enough for the animals to work;

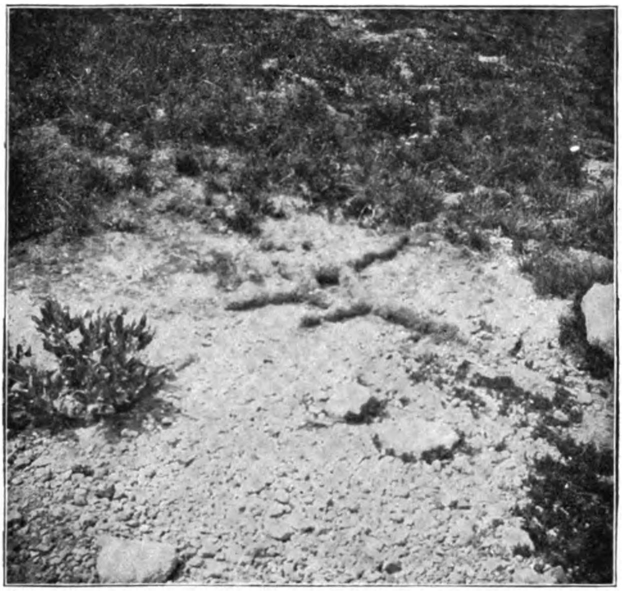

FIG. 31.—Winter earth plugs of pocket gopher.

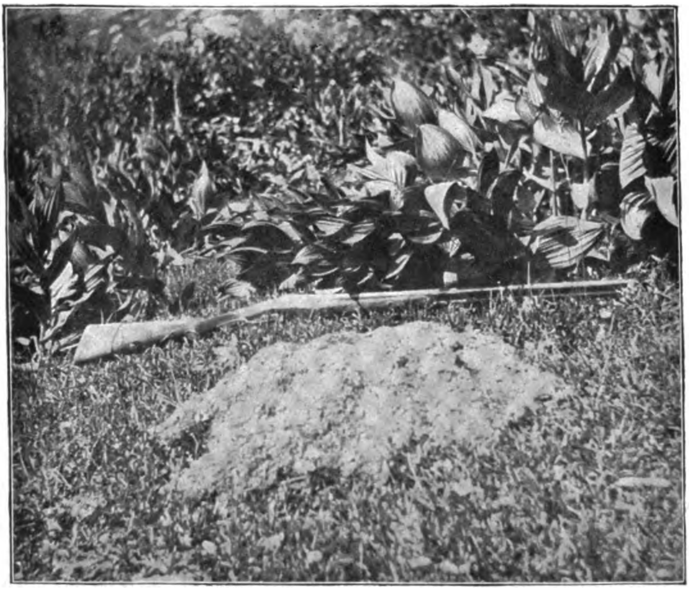

FIG. 32.—Mound made by pocket gopher. (Photographed by W. H. Osgood.)

and on the north side they were abundant nearly up to timberline, both on the main peak and on Shastina.

At Wagon Camp, and thence eastward to Panther Creek, the whole country is honeycombed with their subterranean passages. While we were at Wagon Camp they were unmitigated pests, throwing up little mounds of fresh earth in our midst every day and keeping the ground disturbed the whole time, so that it was impossible to walk in any direction outside of the marsh without stirring up a cloud of dust. I shot several in camp in the daytime, as they poked their heads out of their burrows, pushing little loads of dirt before them. They throw out the earth so rapidly that it is difficult to observe the process accurately. One *appeared* to empty it from his pouches, but I shot him in the act and found his pouches free from dirt and full of cut pieces of roots.

On the higher slopes the winter earth plugs—the cylinders of earth mixed with heather which in winter are pushed up into the snow from the underground passages—remain on the ground all summer, a striking evidence of the absence of rains, for a single hard shower would disintegrate and wash them away. They usually take the form of irregular serpentine ridges; but on Squaw Creek one was found which formed a complete oval ring with radiating cylinders. A photograph of this one, taken August 1, 1898, is here reproduced. (See fig. 31.)

Thomomys monticola pinetorum subsp. nov. Pine-woods Gopher.

Type from Sisson, Siskiyou County, Calif. No. 95152, ♂ ad., U. S. Nat. Mus., Biological Survey Coll. Collected Sept. 4, 1898, by R. T. Fisher. Orig. No. 173.

Characters.—Similar in general to *T. monticola*, but slightly smaller; skull shorter and broader; color very much paler.

Color.—Upperparts pale fulvous, almost orange fulvous (in striking contrast to the much darker colors of *monticola* and *mazama*); nose dusky; sides of head in one pelage plumbeous or slaty faintly washed with buffy; in other pelage strongly washed with ochraceous.

Cranial characters.—Skull, contrasted with that of *monticola*, short and broad, with zygomata much more widely spreading.

Measurements.—Type: Total length, 210; tail vertebræ, 76; hind foot, 28.

Remarks.—Common at Sisson and thence up to Wagon Camp, grading gradually into *T. monticola.*

Dipodomys californicus Merriam. Kangaroo Rat.

Common in the manzanita chaparral on the south side of Shasta from Squaw Creek Valley, near McCloud Mill, up along the road to Wagon Camp, as far at least as an altitude of 4,800 feet, where their unmistakable tracks abounded in the dusty soil. In Shasta Valley they are exceedingly abundant and destructive to grain, according to complaints of the ranchmen. Here W. H. Osgood found their little trails winding about through the sage brush in all directions, and saw fresh tracks in the road every morning.

Perognathus mollipilosus Coues. Mountain Pocket-Mouse.

Common in the manzanita chaparral, a little below Wagon Camp, where four were caught in July by R. T. Fisher. But the most extraordinary locality at which the species was found—and for that matter the most remarkable and abnormal place in which any species of the family has ever been found—is a subalpine pumice basin near timberline at the head of Panther Creek, where Walter K. Fisher discovered it and caught two the night of July 18. Later, six more were secured at the same place.

In Shasta Valley Vernon Bailey and W. H. Osgood found abundant signs of some species of *Perognathus*, but did not obtain specimens. The species is probably *P. parvus*, which is common in the adjacent Klamath Basin.

Erethizon epixanthus Brandt. Porcupine.

Apparently common, and yet not a specimen was obtained. Their characteristic gnawings on the trunks of small trees were seen at many points around the mountain, usually in the Hudsonian or upper part of the Canadian zone. They were common among the dwarf timberline white-bark pines on the north sides of both Shasta and Shastina; and in a small forest of young Shasta firs between Mud Creek Canyon and Cold Creek. Near timberline we several times found small trees whose tops had been gnawed in winter when they protruded above the snow. In a single instance fresh tracks were seen in the trail between Wagon Camp and Squaw Creek Camp (by Vernon Bailey). And on August 4 our favorite mule came into camp with porcupine quills in his nose. C. H. Townsend found porcupines in surprising abundance in Lassen County, south of Shasta, in 1883 and 1884, and gives an interesting account of their habits.

Zapus trinotatus alleni Elliot. Sierra Jerboa.

Fairly common in damp places on and near the mountain. Twenty specimens were collected—fifteen in the Canadian zone in Mud Creek Canyon near the mouth of Clear Creek (alt. 6,700 feet), two near the upper part of Mud Creek (alt. 7,900 feet), and three at Wagon Camp.

One of the most attractive spots near Wagon Camp is a grove of ponderosa pines in which the ground is carpeted with strawberries and scarlet painted cups, mixed with ferns and scattered clumps of serviceberries. The soil, while not wet, receives enough moisture from the little streams that sink into the ground a few rods above to enable these plants to grow in such profusion that they form a continuous meadow—'Castilleja meadow' we called it, from the abundance of painted cups. Here the jerboas abound. We saw several in the daytime, leaping about like frogs in the dense vegetation, and caught one or two in our hands.

In Mud Creek Canyon, W. H. Osgood informs me, they were also frequently seen in the daytime, in wet places under the white hellebore (*Veratrum californicum*).

Zapus pacificus Merriam. Valley Jerboa.

Only two specimens of this little-known species were secured and one of these was destroyed in the trap. They were caught in thickets on the banks of Little Shasta Creek September 20 by R. T. Fisher.

Ochotona schisticeps (Merriam). Cony; Pika.

Relatively rare and confined to small and widely separated colonies. During our circuit of the mountain, made near timberline the latter part of July, we saw what we took to be signs of conies among rocks east of Mud Creek Canyon, but finding no more believed we had been mistaken, until the evening of July 24, when we camped on some rivulets of snow water on the north side of Shastina. Here we found a small scattered colony reaching up in the slide rock from about 8,000 to nearly 10,000 feet, and a specimen was secured by Vernon Bailey. The next day we found signs in Cascade Gulch a mile or two northwest of Horse Camp. Later, when camped in the alpine hemlocks on the small west branches of Squaw Creek, we found a colony in the slide rock close by. Conies were afterwards found on both sides of Red Butte and on the east side of Gray Butte, and Osgood heard one near the head of Mud Creek Canyon. In all, 14 specimens were collected.

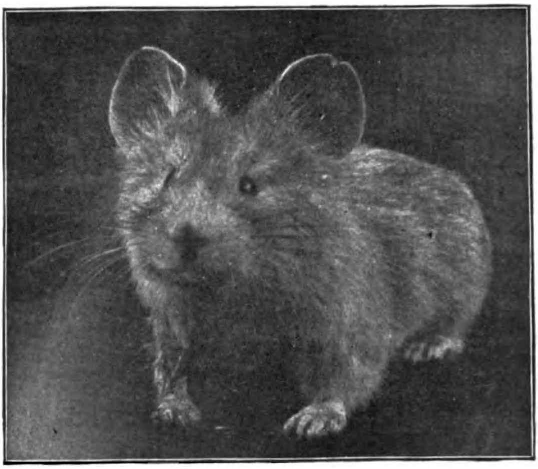

FIG. 33.—Rock cony (*Ochotona schisticeps*)—Photographed by F. Stephens.

This species differs in habits and voice from those of the Rocky Mountains; it is less noisy and less often heard in the middle of the day, for which reason it is more apt to escape detection, and its common note, instead of the usual 'bleat,' is a loud shrill *eh' eh,'* or *eh' eh' eh'*. It seems to be most active in the late afternoon and on moonlight evenings, and its voice is heard at all hours of the night.

On most mountains where conies live, their well known accumulations of plants of various kinds, cut and piled on the rocks to dry, are conspicuous objects. But on Shasta, where I often saw the animals carrying freshly cut plants to their dens in the slide rock, I failed to find a single 'haystack.' In one place a few fresh stems of *Polygonum newberryi*, with its large broad leaves, were seen, and in another a large accumulation of old brown leaves of the same species mixed with a larger quantity of *Phyllodoce empetriformis*—apparently left over from the previous year. But the only real 'haystack' found on the mountain by any of the party was discovered on the east side of Gray Butte September 25 by Vernon Bailey. It contained *Epilobium spicatum*, *Holodiscus discolor*, *Monardella odoratissima*, *Hieracium horridum*, *Ceanothus velutinus*, and two species of grass. The bulk of the material was *Epilobium* and *Monardella*.

On the west slope of Goose Nest Mountain, just east of Little Shasta Valley, Walter K. Fisher found conies common in an area of slide rock which extends in a practically unbroken stretch from the top to the bottom of the mountain. I have not seen the specimens.

Lepus nuttalli Bachman. Sagebrush Cottontail.

Several seen and two secured by W. H. Osgood in the sagebrush in Shasta and Little Shasta valleys, near the north base of the mountain.

Lepus klamathensis sp. nov. Klamath Rabbit.

Type from Fort Klamath, Oregon. No. 92248, ♀ ad., U. S. Nat. Mus., Biological Survey Coll. Collected Jan. 25, 1898, by B. L. Cunningham. Orig. No. 86.

Characters.—Similar to *L. columbiensis* Rhoads, but color fulvous instead of yellowish, with a distinct white stripe on hind foot; skull characters distinctive.

Color.—*Summer pelage:* Upperparts grizzled fulvous and black, the fulvous rather pale and dull, but not at all yellowish as in *columbiensis;* head, face, and pectoral collar dull fulvous; chin, throat, and belly white; a white stripe, sometimes irregular, extending along full length of upper surface of hind foot, on inner side, and usually including toes. *Winter pelage:* Either snow white all over, or like summer pelage but with black hairs much more plentiful.

Cranial characters.—Skull similar to that of *columbiensis* but somewhat smaller and narrower; interorbital breadth at anterior notch less; bullæ decidedly smaller (smallest of the *americanus-bairdi-washingtoni* group); outer face of jugal very deeply grooved anteriorly, and with upper ridge reaching anteriorly beyond end of groove.

Measurements.—Type: Total length, 432; tail vertebræ, 28; hind foot, 127. Average of 3 specimens from type locality: Total length, 410; tail vertebræ, 39; hind foot, 126.

Remarks.—*Lepus klamathensis* is a member of the *americanus-bairdi-washingtoni* group. In color it is intermediate between the yellowish *columbiensis* and the dark fulvous *washingtoni*. In cranial characters it agrees best with *columbiensis*, particularly in the great length of the postorbital processes, but in the small bullæ and peculiar form of the jugal it differs from all known members of the group.

This rabbit is common in the alder thickets in marshy places and along streams near Fort Klamath, Oregon, from which place the late Major Chas. E. Bendire sent me several specimens in the winter of 1883–84; and from which we have recently obtained additional specimens from B. L. Cunningham.

A curious feature about *Lepus klamathensis* is the fact that it sometimes does, and sometimes does not, turn white in winter. In the Biological Survey collection we have brown specimens killed late in January and white ones killed early in April.

This species was not obtained on Shasta, but rabbit dung, supposed to belong to it, was found in many places, particularly under the dwarf *Pinus albicaulis* on the timberline ridges. Rabbit signs and tracks were seen also in the manzanita chaparral, but as no specimens were secured the species is a matter of conjecture.

Lepus californicus Gray. California Jack Rabbit.

Occurs in Shasta Valley at the north base of the mountain. Several were seen and one was killed near Edgewood September 30 by W. H. Osgood.

Odocoileus columbianus (Richardson). Columbia Black-tail Deer.

Abundant on Shasta and throughout the surrounding region. Even at Wagon Camp, which probably is visited by more hunting parties than any other part of the mountain, deer were numerous, and their well-beaten trails were in constant use during our stay. At first the animals were commonest in the lower part of the Shasta fir forest, where for a long time they were not driven away even by the frequent shooting of our bird collectors. When we had been at Wagon Camp a week they were still common within an eighth of a mile. Later, however, they became less numerous in the open forest and more abundant in the dense chaparral of manzanita and buck-brush a little lower down. They were common also on Red Butte, and along all of the streams and canyons on the west, south, and southeast sides of the mountain. On the west side, where water is scarce, numbers used to visit the pools in Cascade Gulch, northwest of Horse Camp. In Mud Creek Canyon their trails were so abundant as to form almost a meshwork. When we visited this canyon first, July 22, Vernon Bailey saw eight deer; and several of us, resting on the west rim of the canyon, watched a doe and fawn on one of the trails on the opposite side. They were so plentiful in a canyon about a mile east of Squaw Creek that I named the place Deer Canyon. Several times during the season does with spotted fawns were seen in the Shasta fir forest. A yearling 'spike-buck' killed on Squaw Creek by Vernon Bailey August 7 was in the velvet, and his worn summer coat was scant and faded. Another 'spike-buck,' killed in the mountains west of Scott Valley September 15, was in the fresh gray winter coat, with only a few red hairs of the summer coat left.

In September the old bucks, which had not been observed earlier, climbed the mountain and began to appear on the higher ridges, where they travel extensively in the timberline tongues of dwarf white-bark pines. On September 18 I followed the tracks of two large bucks along the upper part of Panther Creek and found where they had bedded close together under a low Shasta fir on a steep slope, from which they could overlook the country below.

C. H. Townsend, in his notes on the mammals of northern California, gives an interesting account of this deer.

Odocoileus hemionus (Rafinesque). Mule Deer.

In the region east of Shasta, where the Columbia black-tail is the prevailing species, C. H. Townsend occasionally found the mule deer. "But in Lassen County, a hundred miles farther south, the reverse was found to be the case," and he saw nothing of the Columbia black-tail. This was in 1883 and 1884. The mule deer was not observed on Shasta by our party, although the tracks of an immense buck, seen by me early in August on the rim of Mud Creek Canyon, may have been made by it. Sherman Powell, in a recent article in Forest and Stream (April 27, 1899), states that mule deer are plentiful a little east of Shasta "on and around Glass Mountain, and also on the northeast slopes of Black Fox Mountain."

Cervus occidentalis Ham. Smith. Elk.

One of our party, R. T. Fisher, was informed by George B. Mitchell, county surveyor of Siskiyou County, that elk were shot in the neighborhood of Sisson as late as the early seventies. They were formerly abundant on and about Shasta, particularly in Squaw Creek Valley and Elk Flat, and used to range along the Scott Mountains, and thence westerly to the coast, where a few still exist.

Antilocapra americana Ord. Prong-horn Antelope.

Antelope, we were told, still inhabit the open pine forest east and northeast of Shasta. Formerly they were common in Shasta Valley and ranged west into the foothills of the Scott and Siskiyou mountains.

The following information regarding their distribution was obtained by Walter K. Fisher: In winter they ranged in the country between the Edgewood divide and the foothills of the Siskiyou mountains north of Hornbrook, extending into the low valleys west of Shasta River. They were most plentiful in the region between Little Shasta and Gazelle. Mr. Masgrave, one of the first settlers in Little Shasta Valley, is authority for the statement that formerly they frequently herded with his cattle. In Scarface Valley, west of Gazelle, he once saw a large herd which contained not less than two thousand animals.

In summer the antelope ranged extensively through Goose Nest Mountain and wooded valleys in Butte Creek region, as well as in Shasta Valley, Big Valley, Fall River Valley, and about Tule Lake, Klamath Falls, and Goose Lake. At present only a small herd remains. They stay in the remoter valleys east of the mountains and rarely come to Shasta Valley. In the summer of 1898 three were seen on the road between Little Shasta post-office and Butte Creek.

Ovis canadensis Shaw. Bighorn; Mountain Sheep.

The bighorn no longer inhabits Shasta, but its bleaching bones still remain. In early days, and as late as the seventies, many were killed here by J. H. Sisson, of Sisson Tavern. Sheep Rock, at the northeast base of the mountain, was one of their favorite and latest resorts, but probably was not used during the breeding season. In 1868 George B. Mitchell saw a band of twenty near the head of Mud Creek Canyon. In 1883 C. H. Townsend found numbers of their horns and bones scattered about everywhere on Sheep Rock, and saw the complete skeleton of a bighorn at the foot of Mud Creek glacier, high up on Shasta. An old skull was found on Red Butte by Vernon Bailey during our stay.

Canis lestes Merriam. Mountain Coyote.

Common high up on the mountain, frequenting the pumice slopes above timberline, where their tracks were often seen. Coyotes were especially common east of Mud Creek Canyon, where R. T. Fisher saw two early in August. As no specimens were secured, the species is uncertain, but since *C. lestes* is the animal inhabiting the Sierra farther south and (in a somewhat less typical form) the Klamath country farther north, it is assumed to be the mountain coyote of Shasta.

Canis ochropus Esch. Valley Coyote.

Common in Shasta valley and also at Sisson. R. T. Fisher heard them nearly every night during his stay at Sisson, from the end of August until the middle of September; and about the end of September Vernon Bailey and W. H. Osgood heard them howl at night in the south end of Shasta valley. A little farther north, in the flat valley near Montague, I saw a highly colored one at close quarters in the day time August 31. In July, 1899, Walter K. Fisher secured one in Shasta Valley.

Vulpes macrourus Baird. Mountain Red Fox.

Common on the upper slopes above timberline, where fresh tracks were seen nearly every day; but the animals were very wary and refused to enter our traps.

Urocyon californicus townsendi subsp. nov. Townsend Gray Fox.

Type from Baird, Shasta County, Calif. No. 14130, U. S. Nat. Museum. Collected November 11, 1893, by C. H. Townsend. Orig. No. 49.

Characters.—Similar to *U. californicus* Mearns, but ears decidedly smaller; fulvous tints everywhere darker and richer; rostrum broader; zygomata broader anteriorly; carnassial teeth above and below, larger and thicker. The color of the upperparts and tail is grizzled gray and black, as in *californicus*, but the fulvous of the ears, legs, and underparts is very much darker and somewhat more extensive. The sides of neck and posterior part of throat are rufous, in sharp contrast with the restricted white of the chin and anterior part of throat; the ears are dark grizzled fulvous; the white stripe on the hind foot of *californicus* has disappeared and is represented by a pale streak.

Remarks.—Gray foxes are abundant in the Transition zone about the base of Shasta, and although no specimens were secured by our party a number were obtained by C. H. Townsend in 1883 along the McCloud River.

Felis oregonensis Rafinesque. Oregon Puma; Mountain Lion.

Rather rare, but formerly common on Shasta. In July Bailey saw fresh tracks among the Shasta firs a little below Red Butte. C. H. Townsend obtained seven specimens in Shasta County in 1883 and 1884, several of which were killed near the fish hatchery on the McCloud. He states: "It is practically impossible to raise colts in the Shasta County hills on account of these pests. They destroy many hogs and young cattle also, but do not present so serious an impediment to the keeping of these animals as in the case of horses. Mr. J. B. Campbell, who trapped two panthers for me in 1883, told me that he had actually never seen more than two or three of the numerous colts born on his stock range, as they had been killed and devoured by panthers soon after birth."

Lynx fasciatus pallescens subsp. nov. Wild-cat.

Type from south base of Mount Adams, near Trout Lake, Washington. No. 76585, ♂ ad., U. S. Nat. Mus., Biological Survey Coll. Collected January 10, 1895, by D. N. Kaegi. Orig. No. 23.

Characters.—Similar to *L. fasciatus*, but slightly smaller and everywhere very much paler, particularly the head and face; basal black ear patch (in winter pelage) indistinct or absent; gray ear patch larger; general color hoary gray, contrasted with the dark rich rufous of *fasciatus*. Skull like that of *fasciatus*, but slightly smaller; carnassial teeth and second upper molar less swollen.

Remarks.—Specimens from the region about Shasta (Klamath country on the north and Pitt and McCloud rivers on the south) differ slightly from Trout Lake specimens; they show less tendency to spotting and have slightly larger carnassial teeth and audital bullæ.

This wild-cat is fairly common in the chaparral of the basal slopes of Shasta. One was seen a little below Wagon Camp, and tracks were several times noted by Vernon Bailey in the trail a little above Wagon Camp. Tracks were seen also in Shasta Valley by W. H. Osgood. In 1883–84 C. H. Townsend trapped many wild-cats along McCloud River and the lower part of Squaw Creek, where they were "apparently as numerous as [gray] foxes, and as easily secured." Most of these belong to the present species, but one belongs to the following:

Lynx californicus (Mearns). California Wild-cat.

A specimen which I provisionally refer to this species was obtained by C. H. Townsend at Baird, on McCloud River, in 1883. It is a much smaller animal than *L. fasciatus pallescens* and has conspicuously smaller teeth.

Gulo luscus (Linn.). Wolverine.

We have no positive record of the wolverine from Shasta, but it is known to occur on both the Cascades and the Sierra, and one was killed near Carberry Ranch, between Mounts Shasta and Lassen, about the year 1893 (reported by C. P. Streator).

Wolverines are notorious wanderers and it is most probable that they occur on Shasta at intervals, even if they do not permanently live there—which is by no means certain.

Taxidea taxus (Schreber). Badger.

Very rare on Shasta. In the trail between Wagon Camp and Squaw Creek Camp fresh tracks were seen August 4, by Vernon Bailey, and in Shasta Valley, at the north base of the mountain, badger holes were reported by W. H. Osgood, who also found a dead badger in the road a few miles east of McCloud Sawmill.

Mephitis occidentalis Baird. Large Skunk.

Common in the low country around Shasta. On 'Horse Trail,' leading up the mountain from Sisson, Bailey saw their tracks as high as an altitude of 6,500 feet. At Sisson they are particularly abundant in the wet meadows and thickets, where in September R. T. Fisher caught two along Cold Creek. In Shasta Valley they are also common and several were caught by W. H. Osgood and R. T. Fisher.

Spilogale latifrons Merriam. Little Spotted Skunk.

Not obtained by us, but known to occur in the general neighborhood of Shasta, both north and south of the mountain. In March, 1884, C. H. Townsend caught one on McCloud River, about midway between the mouth of this stream and Mount Shasta.

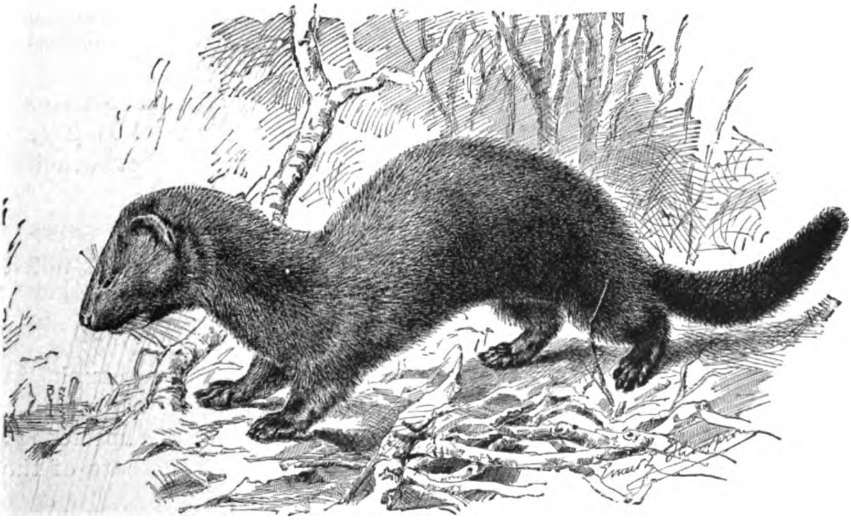

FIG. 34.—Mink. (Drawn by Ernest S. Thompson.)

Lutreola vison energumenos (Bangs). Pacific Mink.

Common along the streams at Sisson, where R. T. Fisher caught two, one on Cold Creek, the other on the upper Sacramento River.

Mustela caurina Merriam. Pacific Marten.

Common in parts of the dense forests of Shasta, particularly on the east side, where many are caught every winter by trappers. We did not succeed in obtaining a specimen, although a line of 'meat traps' was kept out fully a month. Still, fresh tracks were seen in the mud along Squaw Creek a short distance below camp by Vernon Bailey.

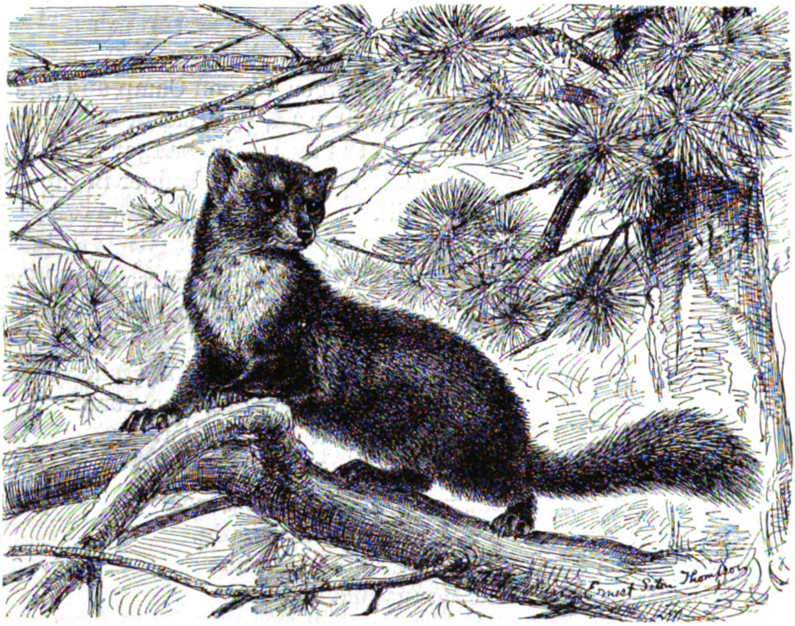

FIG. 35.—Marten. (Drawn by Ernest S. Thompson.)

Mustela pennanti Erxleben. Fisher.

Said to occur in the dense forest on the east side of Shasta, whence skins are brought to Sisson for sale nearly every winter. C. H. Townsend obtained two on McCloud River, about halfway between the mouth of the river and Mount Shasta, in February, 1884.

Lutra hudsonica Lacépède. Otter.

Occurs along the upper Sacramento and McCloud rivers; not noted by our party.

Putorius arizonensis Mearns. Mountain Weasel.

Apparently not common. Early in August three were caught in Mud Creek Canyon, near the mouth of Clear Creek, in traps set in *Aplodontia* runways. It is quite possible that another species, *P. xanthogenys oregonus*, inhabits the low country about the base of the mountain.

Bassariscus astutus raptor (Baird). Cacomistle; Ring-tail Cat.

Not observed by us, but doubtless occurs about the basal slopes of Shasta, as it has been captured both north and south of the mountain.

In February, 1884, C. H. Townsend caught one on McCloud River, about halfway between the mouth of the river and Mount Shasta; he also mentions a Pitt River miner who had a pair alive; and C. P. Streator reports it from old Fort Crook and Carberry Ranch. In September, 1896, one of our collectors, E. A. Preble, caught one in upper Rogue River Valley, near Prospect, Oregon.

Procyon psora pacifica subsp. nov. Pacific Raccoon.

Type from Kechelus Lake, Cascade Mountains, Washington. No. 93137, ad., U. S. Nat. Mus., Biological Survey Coll. Collected Jan. 15, 1898, by C. Hansen.

Characters.—Coloration dark; ground color dark gray instead of buffy; tail rings continuous (not interrupted along median line below); last premolar, first molar, and audital bullæ larger than in *psora*.

Color.—Upperparts dark gray everywhere profusely mixed with and obscured by black hairs; underparts sooty-plumbeous sparingly sprinkled with long buffy whitish hairs; sooty collar under throat continuous and much darker than in *psora;* black rings on tail continuous; pale rings, particularly the last one, obscured above by black hairs.

Measurements.—Type (from dry skin): Total length, 940; tail vertebræ, 310; hind foot, 115.

Remarks.—This new raccoon is most typical in the northwest coast region, particularly about Puget Sound and along the basal slopes of the northern Cascades. Specimens from Pitt River and Little Shasta Valley are much nearer *pacifica* than *psora.*

Raccoons do not occur on the higher slopes of Shasta, but are common about its base. In Little Shasta Valley W. H. Osgood and R. T. Fisher found them particularly abundant about the middle of September, and caught several in traps set under prune trees. The animals were causing much annoyance to the fruit-raisers by nightly visits to the orchards.

Ursus americanus Pallas. Black Bear.

Abundant. When we reached Shasta the middle of July, black bears were exceedingly common throughout the Shasta fir forest. On July 17, in going from Wagon Camp to timberline, we saw fresh tracks of a dozen along Panther Creek, and on the way down, three hours later, saw where four had crossed our trail after we had gone up. Their well-worn trails abounded along Panther Creek and were traversed daily until about the end of July, when, after our collectors had been shooting for nearly two weeks, the bears became alarmed and moved down into the manzanita chaparral below the Shasta firs, where they remained the rest of the season.

Ursus horribilis Ord. Grizzly or Grisly Bear.

Formerly abundant in the Shasta region; now exceedingly rare or absent. W. H. Osgood was told when in Shasta Valley that a few years ago a huge grizzly known as 'Old Clubfoot,' which had been shot at repeatedly, was killed near Goose Nest Mountain, just north of Shasta.

BIRDS OF SHASTA AND VICINITY.

(All dates except where the year is stated are for the year 1898.)

1. **Podilymbus podiceps.** Pied-billed Grebe; Hell Diver.

Several seen in the pond at Big Spring, in Shasta Valley, September 17, by W. H. Osgood. C. H. Townsend obtained it "on ponds near the base of Mount Shasta in summer" in 1883 or 1884.

2. **Anas boschas.** Mallard.

W. H. Osgood shot a mallard in Lower Squaw Creek, near Warmcastle Soda Springs, September 13, and found the species common at Big Spring, in Shasta Valley, September 17. In 1883 C. H. Townsend "found mallards August 1, at the base of Mount Shasta, in certain wet meadows where, in all probability, they had nests."

3. **Querquedula cyanoptera.** Cinnamon Teal.

The commonest duck on the small ponds and streams in Shasta Valley September 17–20 (Osgood).

4. **Spatula clypeata.** Shoveller.

Several seen in Shasta Valley September 17 by W. H. Osgood.

5. **Dafila acuta.** Pintail.

A flock of six seen in Shasta Valley September 18 by W. H. Osgood.

6. **Branta canadensis.** Canada Goose.

Three seen at Big Spring, in Shasta Valley, September 18 (Osgood).

7. **Ardea herodias.** Great Blue Heron.

Seen at Sisson July 13 by W. H. Osgood, and repeatedly observed during the first half of September by R. T. Fisher; several seen in Shasta Valley September 17–20 by W. H. Osgood; common along Shasta River (W. K. Fisher).

8. **Porzana carolina.** Sora Rail.

One seen in Shasta Valley September 18 by W. H. Osgood.

9. **Fulica americana.** Coot; Mud Hen.

One seen among the numerous ducks in the pond at Big Spring, in Shasta Valley, September 18 (Osgood).

10. **Gallinago delicata.** Wilson Snipe.

In Shasta Valley one was seen by W. H. Osgood September 18; and I saw one at Edgewood August 2, 1899. On a small tributary of McCloud River, flowing from the east base of Mount Shasta, one was shot by C. H. Townsend July 25, 1883.

11. **Ereunetes occidentalis** (?) Western Sandpiper.

A flock of small sandpipers supposed to be this species was seen by W. H. Osgood in Shasta Valley September 19.

12. **Totanus flavipes.** Yellow-legs.

A wader believed to be this species was heard in Shasta Valley September 19 by R. T. Fisher.

13. **Helodromas solitarius cinnamomeus.** Western Solitary Sandpiper.

Not observed by us, but in 1883 a male was seen at Sisson on August 3 by C. H. Townsend.

14. **Actitis macularia.** Spotted Sandpiper.

C. H. Townsend secured a spotted sandpiper at Sisson August 2, 1883. Late in July, 1899, Walter K. Fisher found it rather common on Shasta River.

15. **Ægialitis vocifera.** Killdeer.

Common at Sisson, where from July to early September a small flock was always crying and feeding in the meadows between the town and Sisson Tavern. Abundant and noisy in Shasta Valley September 17–20 (W. H. Osgood).

16. **Oreortyx pictus plumiferus.** Plumed Mountain Quail.

Fairly common, but not often seen, in the Shasta fir belt and the manzanita chaparral along its lower edge. Two or three broods were found near Wagon Camp the latter part of July, when the young were hardly a third grown. Several were seen and killed high up on Mud Creek Canyon August 8 by R. T. Fisher and W. H. Osgood, who also saw several flocks in Shasta Valley September 17–20. At Sisson, the first half of September, R. T. Fisher found many small flocks in the dry woods and chaparral west of the village.

17. **Lophortyx californicus vallicola.** California Valley Quail.

Not found on the mountain, but common in Little Shasta Valley, where W. H. Osgood secured a specimen September 19. In August, 1883, C. H. Townsend saw them "in considerable numbers at the base of Mount Shasta," near Sisson.

18. **Dendragapus obscurus fuliginosus.** Sooty Grouse.

Fairly common in the Shasta fir forest, and less so at higher altitudes. At Wagon Camp, during the last half of July, we often saw a hen grouse with half a dozen young; and in a rocky place among the alpine hemlocks near Squaw Creek, in September, we several times ran across a small flock, all full grown, feeding among patches of mountain chinquapin and the dwarf mountain manzanita (*Arctostaphylos nevadensis*). Berries of the latter formed the principal contents of the crop of one killed by Vernon Bailey August 24. Mixed with these berries were seed capsules of *Pentstemon gracilentus* and a few large ants. Usually the grouse were found singly or in bunches of two or three in the forest. When disturbed they generally flew up into the tall Shasta firs, where, instead of remaining motionless like many grouse, they walked about among the branches, stepping deliberately from limb to limb, but keeping on the opposite side from the enemy, so that it was almost impossible to see them.

The old males were sometimes found high up on the lava ridges among dwarf *Pinus albicaulis*, 1,000 feet or more above the continuous forest. When flushed they usually spread their wings and soared down the steep mountain side until lost from sight in the forest below. The 'hooting' or 'booming' of the old males, so often heard in the northern Cascades, was not heard by any of our party on Shasta.

19. **Zenaidura macroura.** Mourning Dove.

Fairly common at Sisson. In Shasta Valley W. H. Osgood found them abundant September 17–20.

[The band-tail pigeon (*Columba fasciata*) was not observed in the region by my party, but in the fall and winter of 1883 C. H. Townsend found it abundant in the foothills of the lower McCloud River, "gathering in the pine trees on the higher ridges in immense flocks."]

20. **Cathartes aura.** Turkey Vulture.

One or two seen at Wagon Camp and between Wagon Camp and Sisson in July; one seen by Walter K. Fisher at timberline, east of Mud Creek Canyon, about the end of July. At Sisson and in Shasta Valley they were more common.

21. **Circus hudsonius.** Marsh Hawk.

Seen at Sisson the middle of July (F. A. M.) and end of August (C. H. M.). Seen in Shasta Valley September 17–20 (W. H. Osgood).

22. **Accipiter velox.** Sharp-shinned Hawk.

Rather rare. One shot near Squaw Creek Camp August 10 by Vernon Bailey; one seen on Mud Creek in August, and several in Shasta Valley by W. H. Osgood September 17–20. C. H. Townsend shot one at timberline on Shasta September 7, 1883.

23. **Accipiter cooperi.** Cooper Hawk.

Rather rare. One killed above timberline (alt. 9,400 feet) above the head of Squaw Creek August 21 by R. T. Fisher. In September 1883, C. H. Townsend shot one near timberline on Shasta.

24. **Accipiter atricapillus striatulus.** Western Goshawk.

One visited our camp at Squaw Creek August 28. It was shot at but not secured. July 28, 1883, C. H. Townsend shot two young goshawks near timberline on Shasta.

25. **Buteo borealis calurus.** Western Red-tail.

Rather common. Seen from time to time at Wagon Camp in July and early August, frequently at Squaw Creek Camp in August and September, and several times above timberline. One was seen flying over the summit of Shasta July 31 by W. H. Osgood and R. T. Fisher. Common during fall migration in Shasta Valley, where Osgood saw many September 17–20, and I saw several September 29—chiefly about the narrow meadows bordering Shasta River. At Sisson Miss Florence A. Merriam saw them September 3.

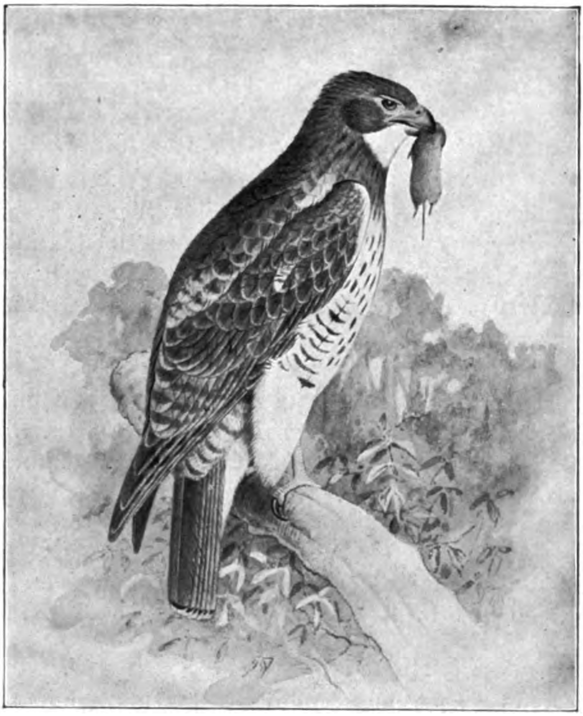

FIG. 36.—Red-tail (*Buteo borealis*). Drawn by J. L. Ridgway.

26. **Buteo swainsoni.** Swainson Hawk.

Rare. July 28 I saw a nearly black Swainson hawk near an abandoned sawmill (alt. 4,800 feet) on the road from Wagon Camp to McCloud Mill. In July, 1899, Walter K. Fisher saw one in Shasta Valley.

27. **Aquila chrysaëtos.** Golden Eagle.

Rather rare, but seen from time to time flying over the mountain, usually at high altitudes. C. H. Townsend shot one near Sheep Rock, at the north base of Shasta, August 21, 1883.

28. **Haliæetus leucocephalus.** Bald Eagle.

In speaking of the bald eagle, C. H. Townsend states that when he had climbed to the extreme peak of Shasta (alt. 14,440 feet), on July 27, 1883, "an eagle came up through the fog that had gathered immediately below us and shared with us our rocky pinnacle above the clouds."

29. **Falco mexicanus.** Prairie Falcon.

Several seen and one shot in the south end of Shasta Valley, at the north base of the mountain, September 30, by W. H. Osgood, who thinks it probable that they breed on the cliffs at Sheep Rock.

30. **Falco columbarius suckleyi.** Black Merlin.

At Wagon Camp, August 8, John H. Sage and I saw a small dark falcon, supposed to be Suckley's merlin, fly into a Shasta fir, but we were unable to shoot it.

31. **Falco sparverius.** Sparrow Hawk.

Common at timberline throughout the summer. Usually seen in the heather patches and among the white-bark pines, where they were feeding on grasshoppers. Several were killed near timberline, east of Mud Creek Canyon, the latter part of July and early August, and one was recorded as high as 13,000 feet by Walter K. Fisher. On the west side of Mud Creek Canyon two were killed August 11 at an altitude of 10,000 feet by Vernon Bailey. Their stomachs were distended with

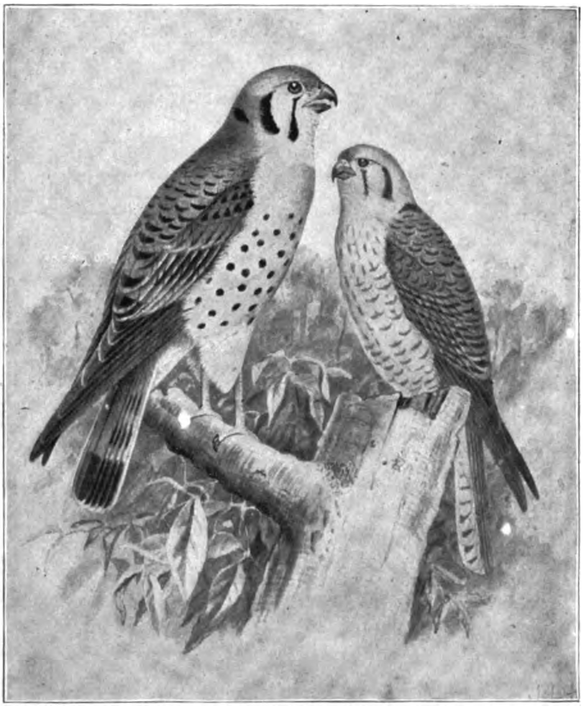

FIG. 37.—Sparrow Hawk (*Falco sparverius*).—Drawn by J. L. Ridgway.

grasshoppers. At the north base of the mountain one was seen by me on the narrow meadows bordering Shasta River in Shasta Valley September 29, and several were observed farther north in the valley September 17-20 by W. H. Osgood and R. T. Fisher. At Sisson they were seen July 15 by Miss Florence A. Merriam.

32. **Bubo virginianus.** Great Horned Owl.

Rare. Feathers were found at two or three places on the mountain, and at Sisson birds were heard hooting.

33. **Speotyto cunicularia hypogæa.** Burrowing Owl.

Not observed by us, but reported by C. H. Townsend as common "on the sage-covered districts north of Mount Shasta," about 15 miles from the mountain.

34. **Glaucidium gnoma californicum.** California Pigmy Owl.

C. H. Townsend obtained two specimens of the pigmy owl August 7, 1883, at the big spring, a mile or two north of Sisson Meadows.

35. **Megascops asio bendirei** (?). California Screech Owl.

A screech owl was heard at Wagon Camp at different times during the season, particularly the latter part of September, but as no specimen was secured there is some doubt as to the subspecies.

36. **Coccyzus americanus occidentalis.** California Cuckoo.

One shot and others seen in July, 1899, by Walter K. Fisher, among the alders and birches on Shasta River east of Edgewood.

37. **Ceryle alcyon.** Kingfisher.

A common resident in the neighborhood of Sisson, where it was seen repeatedly along Cold Creek, at the fish hatchery, and along the upper Sacramento; seen also along Shasta River north of Sisson.

38. **Dryobates villosus hyloscopus.** Cabanis Hairy Woodpecker.

Rather rare. Two or three were seen near Wagon Camp in July; two were collected where the Hudsonian and Canadian zones meet, near Squaw Creek Camp, in August (August 9 and 17); one was seen there September 1, and two were shot in the Transition zone in September (one in Squaw Creek Valley September 13, the other at Sisson September 30). At Sisson R. T. Fisher saw three or four, during the first half of September, in the big firs west of Sisson Tavern.

39. **Dryobates pubescens gairdneri.** Gairdner Woodpecker.

Obtained at Sisson by C. H. Townsend August 3, 1883.

40. **Xenopicus albolarvatus.** White-headed Woodpecker.

A common breeder in the upper part of the pine belt, and also among the Shasta and white firs near Wagon Camp, where several specimens were collected, and where a nest-containing noisy young was found the latter part of July. The nest was in a stub in a burn, with the entrance about 6 feet from the ground. At Sisson the white-headed woodpecker was seen, the middle of July, by Miss Merriam, and early in September by R. T. Fisher. In the pine woods bordering the south end of Shasta Valley I saw half a dozen September 29.

41. **Picoides arcticus.** Arctic Three-toed Woodpecker.

Rare, but evidently breeding in the Shasta fir forest of the Canadian zone, where a male was shot near Wagon Camp by John H. Sage July 20. Another was shot by Vernon Bailey July 30 in the gap between Red Cone and the lower end of Gray Butte, where a third individual was seen.

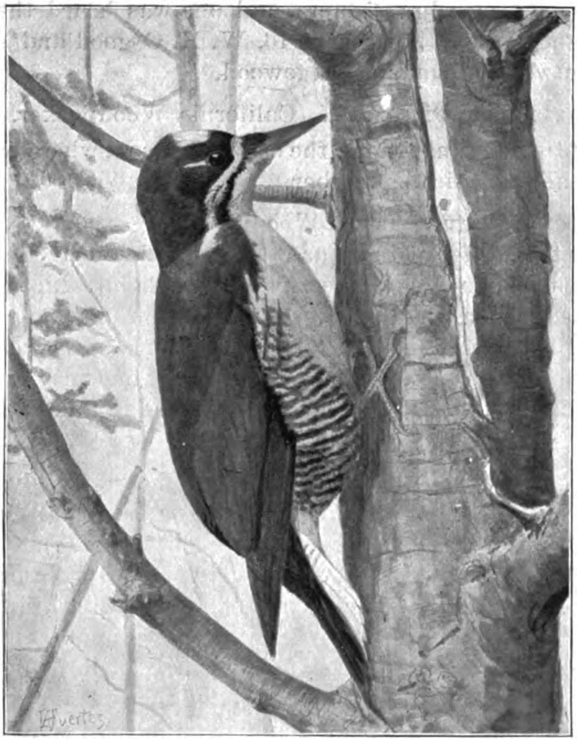

Fig. 38.—Arctic Three-toed Woodpecker (*Picoides arcticus*).—Drawn by L. A. Fuertes.

42. **Sphyrapicus ruber.** Red-breasted Sapsucker.

Fairly common at Wagon Camp, where specimens were collected in July by John H. Sage and Vernon Bailey. One was shot in Mud Creek Canyon about the end of July by R. T. Fisher, and one was seen at Sisson July 15 by Miss Merriam. September 18, one was seen in the brush along Little Shasta Creek by W. H. Osgood. In 1883 C. H. Townsend found the species "in midsummer in limited numbers on the heavily pine-timbered slopes of Mounts Shasta and Lassen."

43. **Sphyrapicus thyroideus.** Williamson Sapsucker.

A male was killed August 4 by R. T. Fisher at timberline on the east side of Mud Creek Canyon. This was the only specimen collected, though others were seen near the same place. August 25, 1883, C. H. Townsend secured one at timberline on Shasta.

44. **Ceophlœus pileatus abieticola.** Pileated Woodpecker.

Fairly common about Wagon Camp, where their loud hammering and unmistakable cries were often heard. Several times in July one visited a tree on the edge of camp, and one was heard there the day we left, September 25. September 16, W. H. Osgood and R. T. Fisher saw three between Sisson and Edgewood.

45. **Melanerpes formicivorus bairdi.** California Woodpecker.

Seen from time to time among the oaks at Sisson, where one was shot by R. T. Fisher early in September.

46. **Melanerpes torquatus.** Lewis Woodpecker.

Common at Sisson and in Squaw Creek Valley near McCloud Mill. July 25 Miss Merriam saw one at Wagon Camp; August 2 W. H. Osgood killed one and saw others high up on Mud Creek Canyon; August 3 I saw a small flock in the Shasta fir forest between Mud and Squaw creeks; August 10 Walter K. Fisher shot one near Squaw Creek; and September 17–20 W. H. Osgood saw several in Shasta Valley.

47. **Colaptes cafer.** Red-shafted Flicker.

Fairly common on the mountain; seen or heard nearly every day, during the latter half of July and early August, near Wagon Camp. July 28 several were seen on the lower slope between Wagon Camp and McCloud Mill; late in July and early in August several were seen high up on Squaw and Mud creeks; August 16 one was killed by R. T. Fisher at Squaw Creek Camp; and during migration, the latter half of September, a few were seen nearly every day a little below timberline near Squaw and Panther creeks. At the time of our visits to the juniper forest in Shasta Valley, September 19 and 29, flickers were common and were probably feeding on the juniper berries. At Sisson, Florence A. Merriam found them common, the middle of July, and R. T. Fisher, the first half of September.

48. **Phalænoptilus nuttalli.** Poor-will.

The unmistakable note of the poor-will was heard in July at Wagon Camp, where the species doubtless breeds. One of the birds was seen on Lower Squaw Creek near Warmcastle Soda Springs August 13 by W. H. Osgood. Others were heard near Edgewood by Walter K. Fisher.

49. **Chordeiles virginianus.** Nighthawk.

Often seen flying at Wagon Camp, on the lower edge of the Shasta fir forest, the latter part of July. Several flocks were seen at Sisson, the first half of September, by R. T. Fisher.

50. Chætura vauxi (?). Vaux Swift.

A couple of miles below Wagon Camp a small black swift was seen by Vernon Bailey about July 24. At Sisson numbers of swifts were seen September 1 and September 10 by R. T. Fisher, and on September 3 by Florence A. Merriam, but they flew too high to be shot.

51. Aëronautes melanoleucus. White-throated Swift.

Several were seen high up on Mud Creek Canyon early in August by W. H. Osgood.

52. Calypte anna. Anna Hummingbird.

Apparently breeding at Wagon Camp, where one was shot July 22 by John H. Sage. Breeds on the lower McCloud River (Townsend).

53. Selasphorus rufus. Rufous Hummingbird.

The commonest hummingbird of Shasta, breeding, apparently, from the lower edge of the Shasta firs to timberline, though it is possible that those seen at high altitudes had moved up to feed from the painted cups in the heather meadows after the breeding season was over. At Wagon Camp, where they were abundant in July and early August, they seemed to feed chiefly from the scarlet painted cup (*Castilleja miniata*).

54. Stellula calliope. Calliope Hummingbird.

Nearly as abundant as *Selasphorus rufus*, and the commoner of the two at high altitudes. In early August both species were constantly hovering over the superb flowers of the scarlet paint brush (*Castilleja miniata*) in the heather meadows near timberline. They were seen also visiting the large yellow blossoms of *Mimulus implexus*, which singular species forms mucilaginous beds in the little streams at and below timberline. Walter K. and R. T. Fisher found them abundant in Ash Creek Canyon about the first of August, particularly among the painted cups and delphiniums.

[*Trochilus alexandri* is recorded by C. H. Townsend as breeding along the lower McCloud, but was not obtained by us. In this connection it should be remembered that we did not collect hummingbirds in the low country, either at Sisson or in Squaw Creek Valley.]

55. Tyrannus verticalis. Arkansas Kingbird.

At Gazelle, on the west side of Shasta Valley, Vernon Bailey saw three on telegraph wires October 31. C. H. Townsend records the species as breeding on the lower McCloud River. In July, 1899, Walter K. Fisher found this kingbird common in Shasta and Little Shasta valleys.

56. Sayornis saya. Say Phœbe.

One was seen about an old windmill in Shasta Valley September 19 by W. H. Osgood.

57. **Contopus borealis.** Olive-sided Flycatcher.

Common at Wagon Camp, where several pairs reared families early in the season, and where, on July 22, Miss Merriam saw a parent bird feeding young in the nest, which was in a fir tree 30 to 40 feet from the ground. In July the species was also seen at Sisson, and in Mud Creek Canyon near the mouth of Clear Creek, on the north side of the mountain.

58. **Contopus richardsoni.** Western Wood Pewee.

A fairly common breeder at Sisson, where Florence A. Merriam saw old birds feeding young in the nest (in a fir tree) July 15.

59. **Empidonax difficilis.** Western Yellow-bellied Flycatcher.

On July 29 I shot one in a thicket of cherry bushes (*Cerasus emarginata*) on the boundary between the Canadian and Transition zones, a little west of Wagon Camp, where it was doubtless breeding.

60. **Empidonax hammondi.** Hammond Flycatcher.

A common breeder near Wagon Camp, in the lower edge of the Shasta firs, where several were collected late in July. Near Squaw Creek Camp, at the upper edge of the Shasta firs, one was shot August 21, and in Mud Creek Canyon at the mouth of Clear Creek, one was shot August 7.

61. **Empidonax wrighti.** Wright Flycatcher.

One was shot at Wagon Camp July 24 by John H. Sage.

62. **Otocoris alpestris merrilli.** Dusky Horned Lark.

Common in places in Shasta Valley, particularly about Montague, where a number were secured by Walter K. Fisher. This is doubtless the form reported by C. H. Townsend, under the name *rubea*, as found "in limited numbers on the sage-covered districts north of Mount Shasta in midsummer." The locality referred to, he tells me, is in Shasta Valley, about 15 miles from the mountain.

63. **Pica pica hudsonica.** Magpie.

One was seen flying over the east side of Shasta Valley, near Sheep Rock, September 29 by Vernon Bailey and W. H. Osgood.

64. **Cyanocitta stelleri.** Steller Jay.

The form of Steller jay of the Shasta region is intermediate between true *stelleri* and the Sierra subspecies, *frontalis*.

It is one of the commonest, noisiest, and best-known birds of the region. Early in the season it was rarely seen above the lower part of the Canadian zone, and was most numerous in the Transition; but on August 2 one came all the way up to Squaw Creek Camp, in the alpine hemlocks, and a few days later a small flock was encountered, screaming, in Mud Creek Canyon at the mouth of Clear Creek. The latter half of September they were common at high altitudes and paid daily visits to our camp on upper Squaw Creek. At Sisson, apparently, they are always common.

65. Aphelocoma californica. California Jay.

Fairly common at Sisson, and more abundant in the lower country farther north. Seen by Vernon Bailey near Gazelle August 31, by W. H. Osgood among the junipers in Shasta Valley September 17 to 20, and by me in the undergrowth along the edge of the open pine and oak forest bordering the south end of Shasta Valley, where it was fairly common, September 29.

66. Perisoreus obscurus. Oregon Jay.

Unaccountably rare on Shasta during our stay. On August 6, when in a dense part of the forest east of the lower end of Gray Butte, I saw a flock of Steller jays, and with them several birds I took to be Oregon jays in the dark plumage of the young. August 20 Vernon Bailey shot one on Horse Camp Trail at an altitude of 6,600 feet, and two days later saw ten in the fir forest between Squaw Creek and Mud Creek Canyon. September 28, on his way around the mountain, he saw three above the point where the wagon road crosses Ash Creek, at an altitude of about 5,900 feet, by far the lowest point at which the species was seen. On July 29, 1899, Walter K. Fisher saw about 15 Oregon jays on Horse Camp trail.

In 1883 C. H. Townsend saw four small flocks (July 30 to September 7) in the heavily timbered forests of Mount Shasta.

67. Corvus americanus. Crow.

A few seen at Sisson. In July, 1889, Walter K. Fisher found them common in Shasta Valley.

68. Nucifraga columbiana. Clark Crow; Nutcracker.

Clark crows are among the most common, most characteristic, and most interesting birds of the higher slopes of Shasta. In summer they are closely restricted to the Hudsonian zone and adjacent rocky slopes immediately above timberline, but in fall they wander far and wide in search of food and are liable to be seen almost anywhere. Two or three, apparently young of the year, visited Wagon Camp, at the lower edge of the Shasta firs, as early as August 8; and in September it was not unusual to see small flocks or single individuals flying over the chaparral belt between Wagon Camp and Sisson.

The usual food of the Clark crow—the large nut-like seeds of *Pinus albicaulis*—having failed in 1898, the birds were feeding mainly on insects. The stomachs of specimens killed at extreme timberline contained in some cases grasshoppers only, in others chiefly beetles (Coleoptera); of those killed lower down, in the alpine hemlocks and Shasta firs, chiefly small hairless greenish caterpillars. They sometimes flew up to masses of yellow lichen, where they seemed to be picking out something to eat. On upper Squaw Creek, August 30, two were seen eating blueberries (F. A. M.). During hot afternoons the latter part of July they were often seen soaring and performing aerial antics above the forest, and also chasing insects in the air, launching out from the tree tops after them like flycatchers. As a rule, they are silent when feeding and noisy when flying about the white-bark pines. When on the ground they are very deliberate, and their broad heads and general form suggest gulls, particularly when the birds are moving away from the observer.

When searching for insects in the young hemlocks they sometimes began at the bottom and worked up, sometimes at the top and worked down. One day in early August a young-of-the-year, showing the true nutcracker spots on the breast, spent some time in camp, feeding in a small tree in our midst without showing the least annoyance at our presence. He began at the top and worked slowly downward, dropping from branch to branch and peering searchingly over the foliage and into the tufts of hemlock needles, often hanging almost bottom side up to pick off the small green caterpillars which infested both the hemlocks and the Shasta firs. We could plainly see him grasp the little caterpillars crosswise and give a big gulp in swallowing them, as if bolting something several times as large. He went over a branch at a time, examining the whole of it carefully before moving to the one below, and sometimes went out so far toward the tip that the slender branch bent down with his weight. Another bird reversed this order of procedure, and after finally reaching the top of the tree gave a jump, aided by a slight flap of the wings, and perched on the very topmost sprig, when, gaining his balance, he opened his bill and uttered a little cry of exultation.

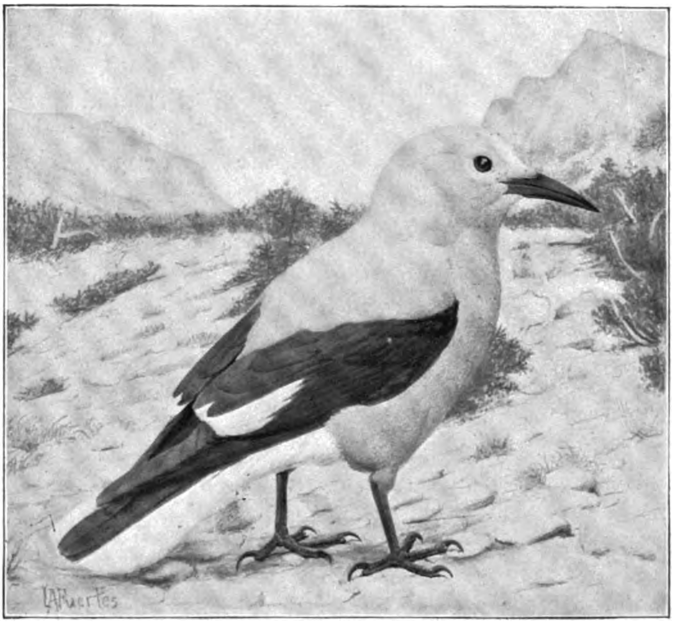

FIG. 39.—Clark Crow (*Nucifraga columbiana*). Drawn by L. A. Fuertes.

Clark crows were almost daily visitors to our camp among the alpine hemlocks on upper Squaw Creek until near the end of August, when they moved up to timberline to feed on the large wingless grasshoppers then abundant along the upper edge of the tongues of dwarf white-bark pines and on the lava-strewn pumice slopes at still higher elevations. Some were seen along the edge of the snow at an altitude of 11,000 feet, where dragon-flies, grasshoppers, and other insects were common.

Clark crow is a little larger than a blue jay, and his colors are put on in blocks. The body is gray; the wings and tail are black and white, in conspicuous contrast. Still, singular as it may seem, this coloration is both directive and protective. When in motion the bird is most conspicuous, the black and white patches flashing with great effect; but when quietly feeding on the ground among the gray lava rocks of the higher slopes it is not easily seen, the gray of the body resembling the gray rocks, the black markings the dark shadows. The coloration, however, is doubtless most protective at night when the bird is at roost in the trees and exposed to its worst enemies, presumably owls and martens. Contrasts of gray or white with black are among the most effective of disappearing colors at night—the black resembling patches of night shadow, the gray the interspaces.

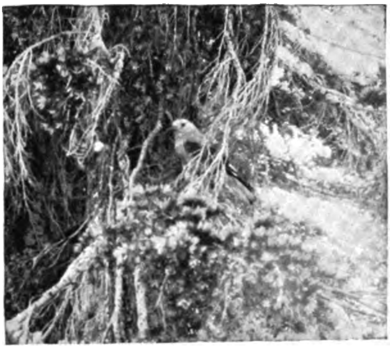

Fig. 40.—Clark Crow (*Nucifraga columbiana*). (Photographed by Walter K. Fisher.)

The true home of the Clark crow is among the white-bark pines of the rocky wind-swept ridges not far from the region of perpetual snow. Here, from the thaws of early spring till the storms of approaching winter, not a day passes without his presence. He is a bold, powerful bird, a fit tenant for such a home, where his loud cry wakes the echoes of glacier cliffs a thousand times oftener than it reaches a human ear.

69. **Cyanocephalus cyanocephalus.** Piñon Jay.

Not an inhabitant of Shasta, but occurs in migration about its base, and may breed in the junipers in Shasta Valley.

September 28, Vernon Bailey saw six in the chaparral and yellow pines at an altitude of 4,000 feet on the wagon road between Elk Creek and Ash Creek, and the next day found a few near Sheep Rock. At Fort Crook, a little southeast of Shasta, a number were collected some years ago by Captain Feilner.

70. **Xanthocephalus xanthocephalus.** Yellow-headed Blackbird.

Not observed by us, but in 1883 C. H. Townsend often saw it "among the flocks of Brewer blackbirds that frequented the timothy meadows of Berryvale, at the western base of Mount Shasta, 3,500 feet altitude." Berryvale is the old name for the meadows near Sisson Tavern.

71. **Agelaius phœniceus.** Red-winged Blackbird.

Common in Shasta Valley September 17 to 20 (Osgood). C. H. Townsend gives it as "an abundant summer resident of the cultivated country north of Mount Shasta."

72. **Sturnella magna neglecta.** Western Meadowlark.

Common in the meadowland at Sisson and Edgewood, and in the narrow meadows bordering Shasta River, in Shasta Valley. At Wagon Camp I saw one in a grassy opening August 13, and a few days earlier Walter K. Fisher saw one in a similar place a little higher on the mountain. In the Sisson Meadows ('Strawberry Valley'), during the first half of September, R. T. Fisher found meadowlarks "gathered in flocks of as many as a hundred birds."

73. **Icterus bullocki.** Bullock Oriole.

Common along streams in Shasta and Little Shasta valleys (W. K. Fisher). Vernon Bailey tells me that at Ager, in the north end of Shasta Valley, some silver poplars in a door yard are literally full of nests of this oriole, and that when he examined them June 26, 1899, the new nests contained young orioles and the old nests young house finches (*Carpodacus m. obscurus*).

74. **Scolecophagus cyanocephalus.** Brewer Blackbird.

Fairly common at Sisson and in Shasta Valley, but not observed on the mountain except in one instance, when several were seen at extreme timberline on the east side of Mud Creek Canyon August 24 by Vernon Bailey and Florence A. Merriam.

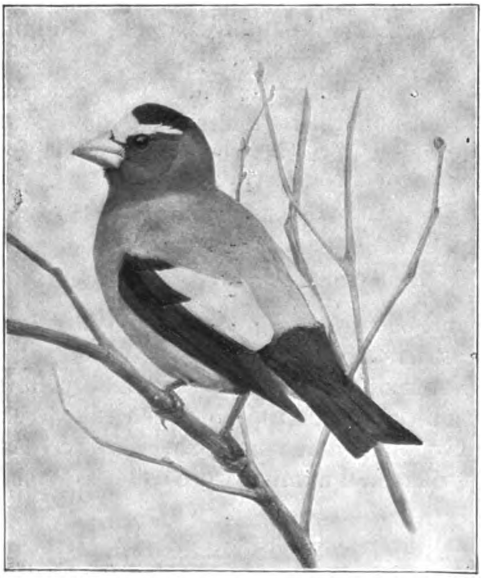

Fig. 41.—Western Evening Grosbeak (*Coccothraustes vespertinus montanus.*) Drawn by L. A. Fuertes.

75. **Coccothraustes vespertinus montanus.** Western Evening Grosbeak.

One of the commonest and most characteristic birds of the Shasta fir belt (Canadian zone), and much less common in the alpine hemlocks (Hudsonian zone). At Wagon Camp, near the lower border of the Canadian zone, small flocks were seen or heard daily whenever the camp was occupied, from the time of our arrival, the middle of July, until our departure, September 25. At Squaw Creek Camp, in the Hudsonian zone, they were much less common, but still by no means rare, and during early August their distinctive call, a short whistle, was heard every day.

In September they were rarely observed on upper Squaw Creek, but September 18 a flock was seen near the head of Panther Creek. They were common in Mud Creek Canyon about the end of July and beginning of August. On September 29 I visited the juniper forest in Shasta Valley, and was surprised to find there dozens of evening grosbeaks, and still larger numbers of Townsend solitaires, feeding on the fat berries of the junipers (*Juniperus occidentalis*). At Sisson in September R. T. Fisher found flocks flying restlessly over the valley.

When in the molt the extraordinary color combinations of the males surpass even those of the crossbills.

76. **Carpodacus cassini.** Cassin Purple Finch.

A common summer resident in the Canadian and Hudsonian zones. Specimens were collected in July and August at various points from Wagon Camp, in the lower edge of the Shasta firs, to timberline, at the upper limit of *Pinus albicaulis;* and during our circuit of the mountain near timberline July 22 to 25 the species was heard or seen every day. At our camp in the alpine hemlocks on upper Squaw Creek, it was common and tame, and in early August usually began singing about daylight. On August 5 I saw one singing in a small white-bark pine on a ridge east of Mud Creek Canyon at an altitude of 8,800 feet, far above continuous timberline. A flock, probably migrating, was observed at the head of Panther Creek September 18.

77. **Carpodacus mexicanus obscurus** (McCall). House Finch.
[= *Carpodacus m. frontalis* Auct].[1]

Common at Sisson and in Shasta Valley, but not seen on the mountain, where it is replaced by the preceding species. At Ager Vernon Bailey found it breeding abundantly in old nests of Bullock orioles.

78. **Loxia curvirostra bendirei** Ridgway. Sierra Red Crossbill.

Red crossbills are common on Shasta. Small flocks were heard nearly every day throughout the season and were frequently seen to light in the tops of the high firs, both at Wagon Camp and Squaw Creek Camp, but they never came into camp to feed, and were rarely seen near by. One was killed at Sisson September 12 by R. T. Fisher, who found the species common there at that time, feeding in the tall pines and also on the garden sunflowers. Several killed by us near timberline lodged in the dense foliage of the alpine hemlocks. C. H. Townsend obtained three specimens on Shasta. The crossbill of Shasta is intermediate between the northern subspecies *minor* and the southern subspecies *stricklandi.* It is the same as the Fort Klamath form named by Ridgway as subspecies *bendirei*; and specimens collected near Mount Whitney in the southern High Sierra by the Death Valley expedition, though published as *stricklandi*,[2] are practically indistinguishable. It is customary among ornithologists to name recognizable intergrades which have definite and clearly defined breeding ranges. On this basis *bendirei* seems entitled to stand, since it occupies the isolated crest of the Sierra Nevada of California from the southern end north to Shasta, and pushes on a short distance into southern Oregon (to Fort Klamath, its type locality). At Diamond Lake, in the southern Cascades, only a few miles north of Fort Klamath, subspecies *minor* occurs. The Diamond Lake specimen[1] was shot by my assistant, E. A. Preble, August 13, 1896, and is an adult male. Owing to the late date and to the well-known erratic habits of crossbills, this bird may have been a wanderer from farther north. Hence the actual northern breeding limit of *bendirei* and the southern breeding limit of *minor* remain to be established.

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[1] For change of name see Oberholser, Auk, XVI, p. 186, April, 1899.

[2] North Am. Fauna, No. 7, p. 81, 1893.

It is a singular fact that two of the specimens obtained by C. H. Townsend on Lassen, between Shasta and the High Sierra, are as large and have as large bills as *stricklandi*. They were killed in summer and may have been stragglers from some of the mountains to the southeast.

79. **Leucosticte tephrocotis** (?). Gray-crowned Leucosticte.

At an altitude of 10,000 to 11,000 feet, on the south side of Shasta Peak, Vernon Bailey saw half a dozen leucostictes August 17, and again the next day. They were feeding among the rocks and on the glacier which occupies the deep cross gulch just below Konwokitan glacier. He tells me they flew down into the crevasses just as we had seen them do on Mount Rainier the previous year. Since none were collected there may be some doubt as to the species. The Sierra bird is *tephrocotis;* the Rainier form *littoralis.*

80. **Astragalinus tristis salicamans.** Willow Goldfinch.

No specimens obtained, but I am sure I saw the species at Sisson in July and August with *A. psaltria.* Walter K. Fisher reports it as common in Little Shasta Valley.

81. **Astragalinus psaltria.** Arkansas Goldfinch.

Common at Sisson and in Shasta Valley; breeds at Sisson.

82. **Spinus pinus.** Pine Siskin.

Fairly common throughout the Shasta fir forest, and ranging thence upward into the alpine hemlocks and white-bark pines. Seen or heard at frequent intervals from the time of our arrival, the middle of July, until late in September.

83. **Ammodramus sandwichensis alaudinus.** Western Savanna Sparrow.

In Shasta Valley W. H. Osgood found this species common September 17 to 20, and just below timberline on Panther Creek I saw several September 18.

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[1] This specimen, an adult male, agrees with specimens of *minor* from Wrangel, Alaska, and Neah Bay and Lapush, Washington.

84. **Chondestes grammacus strigatus.** Western Lark Sparrow.

Not observed on the mountain, but seen at Edgewood August 31, and in the bushes bordering the narrow meadows on Shasta River, in the southwestern part of Shasta Valley, September 29. Ten days earlier W. H. Osgood reported them as common a little farther north in Shasta Valley. At Sisson R. T. Fisher saw two flocks the first half of September. In August, 1883, C. H. Townsend found the species abundant "on the high-lying plains northward of Mount Shasta." In July, 1899, Walter K. Fisher reported it as the commonest bird in Shasta Valley.

85. **Zonotrichia leucophrys.** White-crowned Sparrow.

Probably breeds near timberline in the Hudsonian zone, where, near the head of Mud Creek, one was shot August 4 by W. H. Osgood. About the middle of September numbers were seen just below timberline on Panther Creek—doubtless migrants—and a little later they were common in the bushes from Wagon Camp to Sisson and along Shasta River in Shasta Valley.

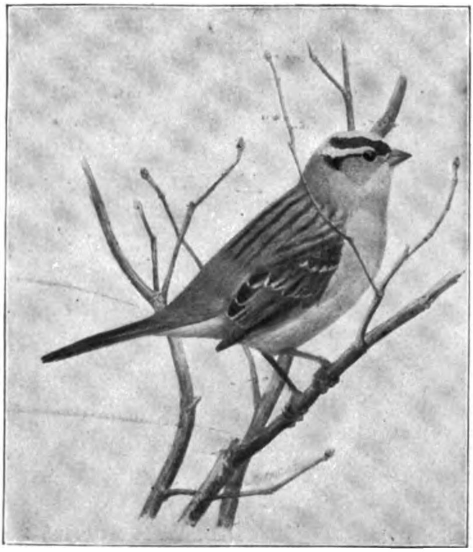

FIG. 42.—White-crowned Sparrow (*Zonotrichia leucophrys*). Drawn by L. A. Fuertes.

86. **Spizella socialis arizonæ.** Western Chipping Sparrow.

As the chipping sparrow is not an inhabitant of dense forests it was not seen in the Shasta fir belt; but in the openings along the lower edge of this belt it breeds, and was feeding young at Wagon Camp in July. After the breeding season it was seen from time to time near timberline. It is a common breeder at Sisson and in Shasta Valley.

87. **Junco hyemalis thurberi.** Sierra Junco.

Common from timberline down to the lower edge of the Shasta firs. The commonest 'ground bird' of the forest. Several nests with eggs or young were found near Wagon Camp the latter part of July.

88. **Melospiza melodia montana.** Mountain Song Sparrow.

Song sparrows supposed to be this subspecies were found breeding at Wagon Camp and Sisson the middle of July. Others were seen in the tules at Big Spring, in Shasta Valley, September 17 to 20 by W. H. Osgood. One was secured at Edgewood July 19, 1899, by Walter K. Fisher, who states that it was the only one seen during his stay.

89. **Melospiza lincolni.** Lincoln Sparrow.

Breeds along the edge of the forest at Wagon Camp, where I shot one at the spring July 20. Another was obtained by R. T. Fisher on Squaw Creek (alt. about 6,700 feet) August 17. Others were seen among the alders in Mud and Ash Creek canyons about the end of July by Walter K. Fisher. At Sisson, the first half of September, R. T. Fisher found the species fairly common, and shot one among the alders bordering Cold Creek. W. H. Osgood reported it as common in Shasta Valley September 17 to 20.

90. **Passerella iliaca unalaschcensis.** Townsend Sparrow.

Common during migration (September) throughout the chaparral of the lower slopes from Sisson up to Wagon Camp. At Wagon Camp one was shot by W. H. Osgood September 22. Common also late in September in bushes in the more open parts of the forest along the east base of Scott Mountains from Sisson north to Edgewood, and in the bushes bordering Shasta River in the southern part of Shasta Valley.

Passerellas supposed to be this species were seen repeatedly at Sisson, the first half of September, by R. T. Fisher.

91. **Passerella iliaca megarhyncha.** Thick-billed Sparrow.

Breeds near Wagon Camp, apparently in the chaparral, where John H. Sage shot one July 20 and another July 22. At Sisson W. H. Osgood and Miss Merriam saw this species July 13 and 15. In the summer of 1883 C. H. Townsend found it a common breeder in the chaparral tracts of Shasta.

92. **Pipilo maculatus megalonyx.** Spurred Towhee.

Common in the undergrowth along the edges of openings in the ponderosa pine forest from Sisson to Shasta Valley. One was shot at Upton September 15 by R. T. Fisher. C. H. Townsend found it breeding commonly on the lower slopes of Shasta in 1883.

93. **Pipilo fuscus crissalis.** California Towhee.

Several seen in the chaparral near Gazelle August 31 by Vernon Bailey, and near Edgewood by Walter K. Fisher.

94. **Oreospiza chlorura.** Green-tailed Towhee.

Apparently a fairly common breeder on the lower slopes of Shasta, where in the chaparral near Wagon Camp several were seen and one was killed the latter part of July and early in August, and one was found feeding full-grown young July 28. At Sisson Miss Merriam found them the middle of July. The last one noted by me was seen in the manzanita at an altitude of 4,900 feet, on the road from Wagon Camp to Sisson, August 26.

95. **Zamelodia melanocephala.** Black-headed Grosbeak.

Seen at Sisson by W. H. Osgood July 13. At the McCloud River fish hatchery C. H. Townsend found it a common breeder in 1883.

96. **Cyanospiza amœna.** Lazuli Bunting.

Common at Sisson (where it was seen feeding young July 15 by Miss Merriam), and ranging thence up through the chaparral of the Transition zone all the way to Wagon Camp, where a nest was found and the parent secured July 17 by W. H. Osgood, who obtained another in Mud Creek Canyon August 3.

97. **Piranga ludoviciana.** Mountain Tanager.

One of the commonest, as well as handsomest, birds of the Shasta fir forest. At Wagon Camp, at the lower edge of the Canadian zone, these tanagers were seen every day from the middle of July until August 10, when that camp was temporarily abandoned. They were very tame, and spent much time in camp, drinking from our little spring and peering at us from the lower branches of the firs. On July 21 I saw several picking caterpillars from the leaves of the buck brush (*Ceanothus velutinus*) in an opening in the firs. Walter K. Fisher states that one sang continuously at his camp in Mud Creek Canyon at the mouth of Clear Creek about the end of July. At Sisson this tanager was seen July 15 by Miss Merriam.

98. **Progne subis hesperia.** Western Martin.

Not observed by us, but recorded by C. H. Townsend, who, in 1883, noticed a few "about some buildings at the west base of Mount Shasta in midsummer." One seen about 6 miles northwest of Edgewood by Walter K. Fisher.

99. **Petrochelidon lunifrons.** Cliff Swallow.

Common at Sisson, where it was noted by Miss Merriam the middle of July, and by R. T. Fisher the first half of September. Abundant in Shasta Valley (W. K. Fisher).

100. **Hirundo erythrogastra.** Barn Swallow.

Common at Sisson, and seen in Shasta Valley September 17 to 20 by W. H. Osgood. Common in Shasta Valley in July (W. K. Fisher).

101. **Tachycineta thalassina.** Violet-green Swallow.

Common at Sisson, and seen once or twice flying over the chaparral, nearly up to Wagon Camp.

102. **Tachycineta bicolor.** Tree Swallow; White-bellied Swallow.

Swallows believed to be this species were seen several times between Wagon Camp and Sisson, and C. H. Townsend records them as abundant breeders on the lower McCloud.

103. **Stelgidopteryx serripennis.** Rough-winged Swallow.

Walter K. Fisher saw some swallows at Edgewood in July, 1899, which he believed to be this species.

104. **Lanius ludovicianus excubitorides.** White-rumped Shrike.

One seen at Gazelle, on the west side of Shasta Valley, August 31, by Vernon Bailey, and one in Shasta Valley September 18 by W. H. Osgood. Rather common in Shasta Valley in July, 1899 (W. K. Fisher).

105. **Vireo solitarius cassini.** Cassin Vireo.

Fairly common along the lower border of the Shasta fir forest at Wagon Camp, where two or three were obtained the latter part of July, and where a nest containing one egg and one young was found by John H. Sage July 31. The nest was in a clump of buck-brush (*Ceanothus velutinus*) only 3 feet above the ground, in open chaparral, near the edge of the Shasta fir woods.

106. **Vireo gilvus swainsoni.** Western Warbling Vireo.

Recorded by C. H. Townsend as "found at rare intervals in midsummer about the base of Shasta." A vireo heard by us several times at Sisson was probably this species. Walter K. Fisher found it at Edgewood, among the bushes along Shasta River, where he secured a specimen July 19, 1899.

107. **Helminthophila rubricapilla gutturalis.** Calaveras Warbler.

Common in the chaparral at Wagon Camp, where several specimens were collected the last half of July. Later the species was seen with other warblers in the trees higher up on the mountain.

108. **Helminthophila celata lutescens.** Lutescent Warbler.

Fairly common and apparently breeding at Wagon Camp, in the lower edge of the Shasta firs, where two were collected July 20. One was shot in the alpine hemlocks on Squaw Creek August 6 by Vernon Bailey.

109. **Dendroica æstiva.** Yellow Warbler.

Seen at Sisson, the middle of July, by Miss Merriam. The only one seen on the mountain was shot in the chaparral near the edge of the fir forest at Wagon Camp July 29 by John H. Sage. Common in bushes along Shasta River in Shasta Valley (W. K. Fisher).

110. **Dendroica auduboni.** Audubon Warbler.

Abundant throughout the forest region of Shasta, from timberline down to the lower edge of the Canadian zone. At Wagon Camp Miss Merriam saw them feeding fullgrown young July 18 and August 1. In August and September they were seen daily at our camp in the alpine hemlocks, often in mixed flocks of chickadees and other birds. When we left Wagon Camp, September 25, they were still common there.

August 9 and 10, spotted young were collected, one with the brown sides coming in and one with the yellow just beginning to show. At Sisson, Miss Merriam saw them the middle of July, and R. T. Fisher found them common the first half of September.

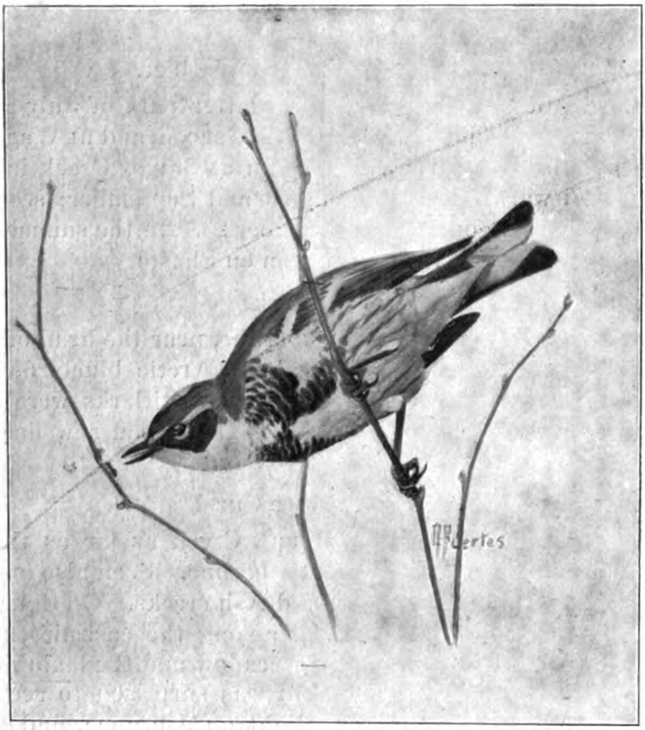

FIG. 43.—Audubon Warbler (*Dendroica auduboni*). Drawn by L. A. Fuertes.

111. **Dendroica occidentalis.** Hermit Warbler.

Fairly common in the Hudsonian and upper part of the Canadian forest during August (collected at Squaw Creek Camp at intervals from August 3 to August 28); not seen in July.

112. **Geothlypis tolmiei.** Macgillivray Warbler.

Seen at Sisson and Wagon Camp about the middle of July, and again at the latter locality August 1 and August 3. One was shot in Mud Creek Canyon at an altitude of 6,700 feet by W. H. Osgood August 7. In July and August, 1883, C. H. Townsend found it not uncommon on the mountain.

113. **Geothlypis trichas occidentalis.** Western Yellow-throat.

At Big Spring, in Shasta Valley, W. H. Osgood found this warbler common in the tules September 17 to 20; and August 6, 1883, C. H. Townsend secured an immature specimen at the base of Mount Shasta.

114. **Icteria virens longicauda.** Long-tailed Chat.

Fairly common at Sisson, and common in the lower country farther north—at Gazelle and on toward Yreka. Common along Shasta River in Shasta Valley (W. K. Fisher).

115. **Wilsonia pusilla pileolata.** Pileolated Warbler.

Common in Mud Creek Canyon the latter part of July and early August; seen at Sisson July 13 by W. H. Osgood, and at Wagon Camp August 3 by Miss Merriam; several seen at Squaw Creek in flocks of chickadees and warblers during August and September; seen in wild cherry bushes at Wagon Camp September 25. In the summer of 1883 C. H. Townsend found it rather common on Shasta.

116. **Anthus pensilvanicus.** Pipit; Titlark.

In a barren rocky basin above timberline, near the head of Panther Creek, on July 17 I heard titlarks and saw Arctic bluebirds. At the same place two months later (September 18) titlarks were common. In Shasta Valley September 17 to 20 W. H. Osgood saw flocks along the road.

117. **Cinclus mexicanus.** Dipper; Water Ouzel.

Common on the upper part of Squaw Creek as far as the timber extends, and sometimes seen above timberline. Seen also on Panther Creek, near its head, and on Mud and Ash creeks. On Squaw Creek we often watched the ouzels feeding among the cascades and clear cold pools between the upper heather meadow and the main fall. One afternoon just before dark (6 o'clock) I was surprised to see an ouzel fly up into the dead top of a tree, light on a branch, and climb up several feet on the trunk with his short tail hanging straight down, after the manner of a woodpecker.

118. **Salpinctes obsoletus.** Rock Wren.

Rather rare on Shasta and confined apparently to the bare rocky slopes near and above timberline. August 2, at an altitude of 8,600 feet, on one of the ridges above the head of Squaw Creek, I found a pair—the first noted on the mountain. August 11, on the west rim of Mud Creek Canyon, I first heard them at 9,000 feet, and Vernon Bailey followed them up and shot one at 9,800 feet. A week later he saw one at an altitude of 10,400 feet. August 27, Miss Merriam saw one in 'The Gate,' between the heads of Panther Creek and Squaw Creek. In 1883 C. H. Townsend found them common above timberline on Shasta, and observed them also on Sheep Rock. In July, 1899, Walter K. Fisher found them among lava ledges in Shasta Valley.

119. **Catherpes mexicanus punctulatus.** Canyon Wren.

Not observed by us, but recorded by Townsend, who in 1883 saw one—doubtless a straggler—above timberline on Shasta, and others at Sheep Rock, at the northeast base of the mountain, where he heard the bird's wonderful song and was deeply impressed by it.

120. **Thryomanes bewicki spilurus.** Vigors Wren.

Seen at Sisson, but not on the mountain. Recorded by C. H. Townsend from "the base of Shasta."

121. **Troglodytes aëdon parkmani.** Parkman Wren.

Rare on the mountain. One collected near Squaw Creek Camp (alt. 6,750 feet) August 18 by R. T. Fisher, and one in Mud Creek Canyon (alt. 6,780 feet) August 9 by W. H. Osgood. More common at Sisson, where it was observed by Miss Merriam the middle of July. C. H. Townsend records it as abundant in midsummer "among the piled-up logs of a certain clearing in the forest at the base of Mount Shasta." The bird seems to be intermediate between *parkmani* and *aztecus*.

122. **Cistothorus palustris paludicola.** Tule Wren.

At Big Spring, in Shasta Valley, W. H. Osgood found these wrens common September 17 to 20.

[The western winter wren (*Anorthura hiemalis pacifica*) was not observed by us, but was found by C. H. Townsend in the mossy canyons of the lower McCloud. It doubtless occurs in the upper canyon of the Sacramento near Sisson, and quite possibly in other suitable places about the mountain.]

123. **Certhia familiaris occidentalis.** Western Brown Creeper.

Not common, but seen now and then in the alpine hemlocks on Squaw Creek and in the Shasta firs, lower down. The earliest record is July 24 (J. H. S.); the latest, September 15 (C. H. M.). At Wagon Camp John H. Sage shot one and saw another July 27; and Miss Merriam saw one in the same place August 1, one at Squaw Creek August 30, and two at Sisson September 3.

124. **Sitta carolinensis aculeata.** Slender-billed Nuthatch.

Not common on the mountain, and only moderately so at Sisson. A few were seen at Squaw Creek Camp from time to time in August, once or twice in the mixed flocks of chickadees and warblers.

125. **Sitta canadensis.** Red-breasted Nuthatch.

Common from the lower edge of the Shasta fir belt up to timberline; and from the time of our arrival, the middle of July, until our departure, the latter part of September. In September it was often seen in mixed flocks with mountain chickadees and Audubon warblers.

126. **Sitta pygmæa.** Pigmy Nuthatch.

In the ponderosa pines near Sisson, W. H. Osgood saw pigmy nuthatches July 13, and I saw a small flock September 30. At the southwest end of Shasta Valley, not far from Edgewood, Osgood saw several in the pines September 20.

127. **Parus gambeli.** Mountain Chickadee.

Common and widely distributed. In the firs at Wagon Camp they were among the commonest birds, and at higher altitudes were seen or heard nearly every day. Early on the morning of July 24, after camping for the night in the shelter of a narrow fringe of dwarf white-bark pines at timberline, on one of the desolate torrent-swept beds of Inconstance Creek, high up on the north side of Shasta, we were saluted by a small flock of these cheerful little birds. In September they helped form the mixed flocks, along with Audubon and other warblers, Canada nuthatches, and other small fry so often seen among the Shasta firs and alpine hemlocks. At Sisson Miss Merriam saw them about the middle of July; they were common there in September, and were noted in Shasta Valley by W. H. Osgood September 17 to 20.

128. **Parus rufescens.** Chestnut-backed Chickadee.

Not observed by us, but recorded by C. H. Townsend, who "obtained a single individual at the western base of Mount Shasta on July 14, 1883."

129. **Psaltriparus minimus californicus.** California Bush-Tit.

Common along Little Shasta Creek September 18 (W. H. Osgood). Seen in the chaparral west of Gazelle, on the west side of Shasta Valley, August 31 (Vernon Bailey). Townsend found it a common breeder near the fish hatchery on the Lower McCloud River.

130. **Regulus satrapa olivaceus.** Western Golden-crowned Kinglet.

Both kinglets are common on Shasta and doubtless breed in the Shasta firs of the Canadian zone. The golden-crown was often seen and heard at Wagon Camp, where it was collected July 18. It was also common just within the lower edge of the fir forest in Mud Creek Canyon July 23, and a couple of miles higher up about the end of the month. C. H. Townsend obtained specimens at timberline in July, 1883.

131. **Regulus calendula.** Ruby-crowned Kinglet.

The ruby-crown was frequently heard by various members of the expedition, and at different altitudes, from Wagon Camp in the lower edge of the Shasta firs, to timberline, where one was collected by W. H. Osgood August 4. In 1883 C. H. Townsend obtained two specimens, one at timberline August 15, the other at an elevation of about 6,000 feet September 2.

132. **Myadestes townsendi.** Townsend Solitaire.

Not an uncommon breeder on the higher slopes of Shasta, where I saw six during our stay. The lowest of these was at Wagon Camp, in the lower edge of the Shasta firs, where one drank at our spring July 31. The others were in the Hudsonian zone, and most of them in the alpine hemlocks at or near our camp on Squaw Creek, just below timberline.

They were usually seen in early evening when they came to drink from the little streams in the forest, and were always silent and rather shy. Late in July and early in August they were seen with arctic bluebirds by Walter K. Fisher at and below timberline near Mud Creek Canyon. They probably winter in the junipers in Shasta Valley, where W. H. Osgood saw them September 17 to 20, and where I saw dozens feeding on the juniper berries and singing freely September 29. Late in July, 1883, C. H. Townsend found one of these birds "frozen in the snow and ice which filled the crater of the extinct volcano of Shasta."

133. **Hylocichla aonalaschkæ auduboni.** Dwarf Hermit Thrush.

Evidently breeds in the dark Shasta fir forest of the mountain and in the damp forest of white and Douglas firs near Sisson Tavern, where Miss Merriam heard them in full song the middle of July. At Wagon Camp W. H. Osgood shot one July 17; and near Squaw Creek Camp I shot another September 20. C. H. Townsend records it from the southern slope of Shasta under date of July 25.

134. **Merula migratoria propinqua.** Western Robin.

Robins were fairly common at Wagon Camp, where we heard their evening song the day of our arrival, July 15, and where they were seen carrying food to young July 26 (F. A. M.). Higher up they were seen from time to time, but were not common. Along the upper part of Mud Creek Canyon Walter K. Fisher found them "fairly common but erratic" the latter part of July and first few days of August. At Squaw Creek Camp, in the alpine hemlocks, we saw a flock on the morning of August 12, and others September 15. Just below timberline on Panther Creek a few were seen migrating September 18. In Shasta Valley they were common among the junipers September 29. At Sisson they are common breeders, and a few were seen whenever any of our party were there, from July 14 until the end of September. A nest containing three eggs was found July 13 by W. H. Osgood.

135. **Sialia mexicana occidentalis.** Western Bluebird.

A common breeder at Sisson, where families, including lately fledged young, haunted the fences the first half of September (R. T. Fisher). In Shasta Valley W. H. Osgood found them common September 17 to 20, and a few small flocks were seen by me among the junipers September 29. At Sisson the species was common the latter part of September. In 1883 a nest containing nearly grown young was found by C. H. Townsend in a post hole in the ground at Sisson Tavern late in July.

136. **Sialia arctica.** Mountain Bluebird; Arctic Bluebird.

A common breeder on the higher slopes of Shasta, where they were constantly seen in July and early August, but rarely afterwards. On our first visit to timberline, July 17, they were very abundant on the bare rocks above timberline near the head of Panther Creek, and a week later were seen on the rim of Mud Creek Canyon. On the rocky slopes at and above timberline on the east side of Mud Creek Canyon early in August they were the most characteristic birds (W. K. Fisher); and they were seen near the same place August 18 (V. Bailey). September 20 a small flock visited our camp on upper Squaw Creek.

In July, 1883, C. H. Townsend found the species abundant at timberline, where full fledged young accompanied their parents.

NOTES ON THE DISTRIBUTION OF SHASTA PLANTS.

The study of the geographic distribution of animals and plants in the Sierra-Cascades can not be completed until authentic lists of species are brought together from several important localities from which at present no data are available. The need of such lists, with detailed altitudes and zone positions, is particularly urgent in the case of detached mountains, as Shasta and Lassen, which are separated from each other and from the continuous ranges on either side by gaps low enough to be broadly filled by Transition zone species. The Boreal species of these mountains, being thus completely cut off from the nearest corresponding colonies, form islands in the long Boreal chain that stretches southward from British Columbia to southern California.

The present imperfect list of the plants of Mount Shasta is offered as an humble contribution toward the needed material. It is based almost wholly on my own personal observations and is known to be far from complete. More pressing work along other lines made it impracticable to give much time to plants, and the date of arrival at the mountain (the middle of July) was so late that many of the early flowering species had disappeared. The Boreal species, owing to their greater importance, have received most attention; the Transition zone species least. In the case of Alpine and Hudsonian species it is believed that few remain to be added.

I am indebted to Miss Lewanna Wilkins for collecting and pressing most of the plants preserved during the first six weeks of our stay on the mountain; and to John H. Sage for the use of a collection made by him during the same period. The plants obtained subsequent to August 8 were collected by Vernon Bailey and myself

Although two seasons' field work in the Cascade Range had given me a certain acquaintance with the more conspicuous plants common to these mountains and Mount Shasta, I was still much handicapped in the determination of the species, and not being a botanist myself was obliged to appeal to professional botanists for assistance. I am indebted most of all to Miss Alice Eastwood, curator of the herbarium of the California Academy of Sciences, whose courtesy and promptness in identifying plants, sent her from time to time while I was still in the field, were of the utmost assistance. I am also particularly indebted to Prof. E. L. Greene, of the Catholic University at Washington, who has taken the trouble to examine a large number of species, and to describe several which proved to be new. Other botanists who kindly determined special species or special genera are Mrs. N. L. Britton, Mr. Frederick V. Coville, Prof. W. R. Dudley, Mr. M. L. Fernald, Mr. John B. Leiberg, Mr. C. L. Pollard, Dr. B. L. Robinson, Dr. J. N. Rose, Prof. P. A. Rydberg, Mr. J. K. Small, and Prof. William Trelease. In order to properly place the credit for this assistance, the botanist responsible for the identification is in each instance mentioned. Where no one is named I am personally responsible.

A few mosses and ferns were found in the timberline region of Shasta. The mosses, kindly determined by Mrs. Britton, are *Harpidium* (*? exannulatum* Gumb.), *Aulacomnium androgynum* Sch., and a species of *Philonotis*. They are confined rather closely to the borders of the alpine streams, where the *Aulacomnium* forms compact mats of a yellowish color.

The ferns have been determined by Mr. William R. Maxon through the courtesy of Mr. Frederick V. Coville, curator of the National Herbarium. The species which grow sparingly in the heather meadows and under the edges of rocks near timberline are: *Dryopteris aculeata scopulina* (Eaton), *Cystopteris fragilis* (L.) Bernh., *Cheilanthes gracillima* D. C. Eaton, *Cryptogramme acrostichoides* R. Br., and *Phegopteris alpestris* (Hoppe) Mett. Much lower down, along the boundary between the Canadian and Transition zones, *Pteris aquilina lanuginosa* (Bory) Hooker, and *Asplenium filixfœmina* (L.) Bernh. occur. The brake (*Pteris*) is very abundant on the pumice sand at Wagon Camp and Sisson and wherever there is sufficient moisture in the soil in spring and early summer. The black-beard lichen (*Alectoria fremonti*) and the handsome yellow tree lichen (*Evernia vulpina*) abound in the dark forest of Shasta firs.

In the chapter on 'Life Zones' the more distinctive species have been grouped according to their vertical distribution (see pp. 52–68), but for convenience in finding the notes relating to particular species, they are here arranged in systematic order. In the case of certain plants found by us only on the borderland between adjacent zones, the zone position is in doubt and must be determined by future study.

The most important kinds of plants from the standpoint of geographic distribution are naturally those that remain longest in a particular spot. Hence, as pointed out by Coville,[1] trees, shrubs, and perennials are the kinds most useful in determining zone boundaries. For this reason little attention is here given to annuals.

Pinus monticola Douglas. Silver Pine; Mountain White Pine.

Common in places, chiefly in the upper half of the Canadian zone, but local and by no means generally distributed. Wherever it occurs it is mixed with Shasta firs, and in places it reaches up high enough to overlap the lower edge of the black alpine hemlocks and white-bark timberline pines. (See p. 38.)

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[1] Botany of Death Valley Expedition, pp. 17–18, 1893.

Pinus lambertiana Douglas. Sugar Pine.

Fairly common in most parts of the Transition zone forest of ponderosa pines, and occurring here and there in the immense areas of chaparral that cover the lower slopes on the south and west sides of the mountain. (See pp. 32–33.)

Pinus albicaulis Engelmann. White-bark Pine.

The timberline tree of Shasta, which it encircles at altitudes ranging, according to slope, from about 7,000 up to 8,000 feet, and pushing up on the warmest ridges to an extreme elevation of 9,800 feet. In its distribution therefore it fills the Hudsonian zone except in places unsuited to tree growth. The only tree competing with it on Shasta is the black alpine hemlock, which, requiring more moisture, is at a disadvantage and is confined to special localities, as explained in full under that species. (See pp. 39–42.)

Pinus ponderosa Laws. Ponderosa or Yellow Pine.

The most abundant and characteristic tree of the lower slopes and basal plane of Shasta, where, filling the Transition zone, it forms a continuous open forest of wide extent. (See pp. 30–32.)

Pinus murrayana Balfour. Lodge-pole Pine.

Confined to the northeast quadrant of Shasta, where it occupies the lower part of the Canadian zone. (See pp. 38–39.)

Pinus attenuata Lemmon. Knobcone Pine.

Common in a limited area in the Transition zone on the south side of Shasta, where it is confined to the lower slopes (from about 4,000 to 5,600 feet altitude) from Panther Creek easterly to between the branches of Mud Creek. (See pp. 33–34.)

Tsuga mertensiana (Bong.) Carr.[1] Black Alpine Hemlock.

A characteristic tree of the Hudsonian zone, where, however, it is not generally distributed for the reason that the upper slopes of Shasta are in most places too dry for it. It occurs in the same belt with *Pinus albicaulis*, but does not reach so high, and, requiring more moisture, is confined to disconnected localities, usually in canyons and gulches or along the shady sides of buttes or ridges. (See pp. 42–46.)

Pseudotsuga mucronata (Raf.). Sudw. Douglas Fir or Spruce.

Common, scattered through the less arid parts of the forest of ponderosa pines which clothes the lower Transition zone slopes of Shasta and extends away in all directions (see p. 32). A subspecies *pendula* (Engelm.) Sudworth, with "branches, at least the lower ones, very slender and long-pendent," has been described from Sisson (Bot. Calif., II, 483, 1880; Sudworth, Check List Forest Trees of U. S., 24, 1898), and is common thence westerly to the coast. (See pp. 34–35).

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[1] For change of name from *Tsuga pattoni* to *T. mertensiana*, see footnote p. 42.

Abies shastensis Lemmon. Shasta Fir.

The dominant tree of the Canadian zone, covering the middle slopes and completely encircling the mountain in a solid belt about 2,000 feet in vertical breadth. Its upper border overlaps the lower edge of the Hudsonian; its lower border, the upper edge of the Transition. Along Panther and Squaw creeks, on the south slope, it ranges from about 5,500 up to 7,500 feet, and on steep southwesterly slopes considerably higher. (See pp. 36–38.)

Abies concolor lowiana (Murray) Lemmon. White Fir.

The common and only true fir of the basal slopes of Shasta, where it occurs in moist places from the altitude of Wagon Camp (5,700 feet) down to the very bottom of Sisson Valley at the base of Mount Eddy (alt. 3,400 feet). It thus fills the Transition zone, except in places that are too dry for it. (See p. 34.)

Libocedrus decurrens Torrey. Incense Cedar.

Common throughout the Transition zone forest of ponderosa pines, except in the dryest places. (See p. 35.)

Chamæcyparis lawsoniana (Murray) Parlat. Lawson Cypress.

Attributed to "the Shasta Mountains" (Bot. Calif., II, p. 115, 1880), but not found by us.[1]

Juniperus nana Willd. Dwarf Alpine Juniper.

Fairly common in places close to timberline, usually associated with *Pinus albicaulis* in the upper part of the Hudsonian zone. On Shasta it usually grows in small patches less than a foot high and, as a rule, only a few feet in diameter; in the Olympics, on Mount Rainier, and on numerous other mountains it forms much larger patches. Between Mud Creek Canyon and the high ridges above Squaw Creek, it pushes up to extreme timberline at 9,800 feet, along with *Pinus albicaulis.* On the north side of Shasta and Shastina it was found in crevices among the sharp lava rocks at altitudes varying from 8,300 to 9,000 feet, and was common on the curious *albicaulis* plain stretching westerly from 'North Gate' to Bolam Creek.

Juniperus occidentalis Hooker. Western Juniper.

Abundant in the south end of Shasta Valley, where it forms a forest many miles in extent. Scattered trees begin 4 or 4½ miles easterly from Edgewood, and become more and more plentiful to the north until, at a distance of about 5 miles south from Big Spring, they suddenly become abundant and cover the whole country east of the main mass of lava buttes, forming a continuous juniper forest which fills the southern part of Shasta Valley and reaches northward, I am told, into Little

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[1] Another cypress attributed to Shasta but not seen by us is *Cupressus macnabiana* Murr., "originally reported by Jeffrey from Mount Shasta at 5,000 feet altitude" (Bot. Calif., II, p. 114, 1880). In both instances, probably, the term 'Shasta' was used in a rather loose sense, as covering adjacent mountains not then named.

Shasta Valley. When visited about the end of September, the trees were full of their large berries, and many birds, including evening grosbeaks and Townsend solitaires, were there in numbers feeding on them. The zone position of this tree, which appears to be the type form, is high Upper Sonoran and low Transition. The boreal form common in the Sierra, but not found on Shasta, should be different.

Sitanion cinereum J. G. Smith. Alpine Grass.

The common grass of the glacial meadows, but nowhere sufficiently abundant to form anything like a sod. It is closely related to *S. elymoides* Raf., from which it has been recently separated by Mr. Jared G. Smith.

Carex breweri Boott. Alpine Carex.

Common in the glacial meadows and scattered sparingly over the moist slopes. (Identified by F. V. Coville.)

Juncus parryi Engelm. Parry Juncus.

Common in the heather patches and other moist places from slightly below timberline up through the Alpine zone. Noted by Vernon Bailey as high as 11,300 feet. (Identified by F. V. Coville.)

Allium validum Watson. Large Wild Onion.

Abundant in the Canadian zone along the streams of the Shasta fir belt, and often growing in the lower heather beds along the lower border of the Hudsonian zone. (Identified by Professor Greene.)

Allium sp. —?

A very small species is common in the glacial meadows at the head of Squaw Creek, but matures so early that we were unable to obtain anything but the bulbs.

Calochortus nudus Watson.

Fairly common along the lower edge of the Canadian zone near Wagon Camp, flowering late in July. (Identified by Miss Eastwood and Professor Greene.)

Calochortus maweanus Leichtlin.

Not rare at Wagon Camp, but not seen elsewhere. An elegant little species with white hairy flowers. (Identified by Professor Greene.)

Fritillaria atropurpurea Nutt.

Common in the chaparral of the Transition zone basal slopes from Sisson up to Wagon Camp. (Identified by Miss Eastwood.)

Hastingsia alba (Durand) Wats.

Common near Wagon Camp, where its long and slender cylindrical spikes were in flower the latter part of July. (Identified by Miss Eastwood and Professor Greene.)

Lilium parvum Kellogg. Tiger Lily.

Common in marshy places in the lower part of the Shasta fir belt, particularly at Wagon Camp, where it was flowering abundantly about the middle of July, and was still in fruit as late as the end of September. (Identified by Miss Eastwood.)

Lilium washingtonianum Kellogg. Washington Lily.

This superb lily, with large white and very fragrant flowers, is common in the manzanita in the upper part of the Transition zone, and occurs sparingly at lower altitudes. At Sisson it was in fruit the end of September. The flowers had passed their prime by the middle of July, but occasional plants were found in blossom as late as the end of the month.

Tofieldia occidentalis Watson.

Common near the bottom of the Canadian zone at Wagon Camp. (Identified by Professor Greene.)

Tritelia ixioides (Ait.) Greene (=*Brodiæa*).

Common at Wagon Camp on the border between the Canadian and Transition zones, where its yellow star flowers were in bloom the latter half of July. (Identified by Professor Greene.)

Vagnera stellata (Linn.) Morong.

Common at Wagon Camp, particularly in open grassy places along the edges of the fir forest, where it was flowering abundantly when we reached the mountain, the middle of July. Plants still holding their fruit were observed when we left Wagon Camp, September 25.

Veratrum californicum Durand. White Hellebore.

Abundant at numerous localities along the streams and in marshy spots in the Canadian and upper part of the Transition zones. Particularly common at Wagon Camp, and also on Squaw Creek just above the middle meadow.

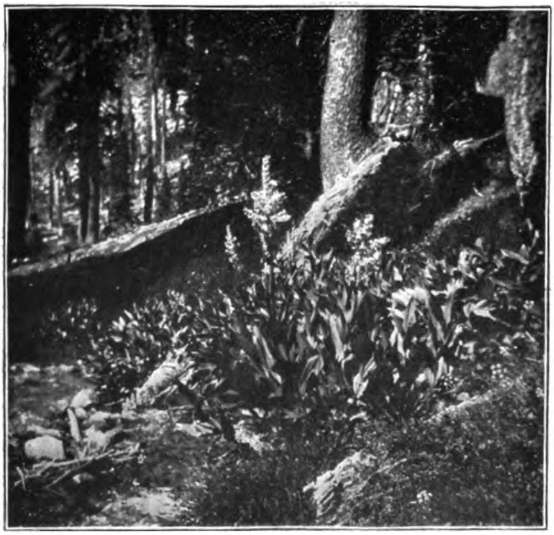

FIG. 44.—White Hellebore (*Veratrum californicum*). Photographed by W. K. Fisher.

Smilax californica Gray. California Smilax.

Occurs in places in the lower part of the Transition zone along Shasta River between Edgewood and Sisson, but nearer Sisson. Not observed elsewhere.

Sisyrinchium bellum Watson. Blue-eyed Grass.

Fairly common in the Transition zone near Wagon Camp.

Corallorhiza bigelovi Watson.

Not uncommon in the woods near Wagon Camp. (Identified by Professor Greene.)

Habenaria leucostachys (Lindl.) Watson.

Common in the marsh at Wagon Camp. (Identified by Professor Greene.)

Habenaria unalaschensis Watson.

A boreal species, fairly common in the marsh near Wagon Camp, growing with the last. (Identified by Professor Greene.)

Populus trichocarpa T. & G. Western Balsam Poplar.

Common in the upper Sacramento Canyon near Sisson, and less so along Shasta River at the south end of Shasta Valley.

Salix lasiandra Bentham. Black Willow.

Abundant in cool moist places about Sisson. (Identified by Miss Eastwood.)

Salix nuttalli Sargent. Nuttall Willow.

Common in moist places in canyons of the Canadian zone and near Wagon Camp. (Identified by F. V. Coville.)

Salix sitchensis Sanson. Sitka Willow.

Common in canyons in the Canadian zone. Found in Mud Creek Canyon near the mouth of Clear Creek. (Identified by F. V. Coville.)

Alnus rhombifolia Nutt. White Tree Alder.

Observed only on Shasta River in the southern part of Shasta Valley, where its zone position appears to be Upper Sonoran. Shasta Valley is one belt lower than the rest of the region about Shasta and contains a dilute tongue of Upper Sonoran species that come in from the north by way of Klamath River Valley.

Alnus sinuata (Regel) Rydb. Alder.

Common in moist places in the canyons of the Canadian zone. In Mud Creek Canyon noted as high as 6,700 feet. Found also near Wagon Camp. (Identified by F. V. Coville.)

Alnus tenuifolia Nutt. Paperleaf Alder.

[=*A. incana var. virescens* Wats].

A Transition zone species common along streams in the neighborhood of Sisson Tavern and along the east base of Scott Mountains. (Identified by F. V. Coville.)

Betula occidentalis Hooker. Birch.

Fairly common along Shasta River at the south end of Shasta Valley. Not observed elsewhere.

Corylus rostrata californica A. DC.

Fairly common in the Transition zone in Squaw Creek Valley near McCloud Mill, and probably elsewhere at the base of the mountain.

Castanopsis sempervirens (Kellogg) Dudley. Sierra Chinquapin.

The distribution of the mountain chinquapin on Shasta is discontinuous. It is possible that two forms exist, one apparently restricted to the manzanita chaparral of the Transition zone from Sisson up to the lower edge of the Shasta fir belt; the other to the scattered stretches of *Pinus albicaulis* of the Hudsonian zone, where it reaches timberline on the rocky slopes and ridges.

Prof. William R. Dudley, of Stanford University, California, has, at my request, kindly looked up the proper name for the boreal Sierra chinquapin, which he finds to be *sempervirens* of Kellogg.[1] The type locality of *sempervirens* is the west slope of the Sierra near Mariposa. I have found the species abundant on a ridge near a stage station called Chinquapin, between Mariposa and the Yosemite, where it occurs with *Pinus jeffreyi*, *P. lambertiana*, *Abies magnifica*, *Pseudotsuga mucronata*, and *Prunus emarginata* at and above an altitude of 6,200 feet. The locality, therefore, is along the overlapping borderland between the Transition and Canadian zones.

Professor Dudley tells me that the 'var. *minor*' Bentham is the small southern coast range form of the true coast chinquapin, *Castanopsis chrysophylla*, and that the type locality is the Santa Cruz Mountains. *C. chrysophylla* is a handsome tree 75 to 125 feet in height, with large leaves, ending in long, slender attenuate points; *C. sempervirens* is a bush with small and relatively bluntly rounded leaves. I found both species common on the Trinity Mountains: *C. chrysophylla* on the sunny lower slopes in the Transition zone; *C. sempervirens* on the cold summit in the lower edge of the Canadian zone, where it is associated with *Arctostaphylos nevadensis*, *Cerasus emarginata*, *Ceanothus velutinus*, the dwarf mountain form of *Quercus chrysolepis*, and the very distinct *Q. vaccinifolia.*[2]

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[1] Proc. Calif. Acad. Sci., I, p. 75, 1855 (reprint).

[2] *Quercus vaccinifolia* Kellogg is another excellent species, usually confounded with the dwarf mountain form of *Q. chrysolepis*, with which it has nothing to do. Their zone relations are much the same as those of the two species of *Castanopsis*, for *Q. vaccinifolia* occurs along the lower edge of the Boreal, and ranges up through the Canadian zone, always in rocky places, while *Q. chrysolepis* belongs to the Transition zone. Their ranges join where these zones meet, and I have found both growing side by side on the Trinity Mountains, and also on the Sierra. *Quercus chrysolepis* is a Transition zone tree which at the upper limit of its range is always dwarfed and often reduced to a shrub; but irrespective of size it always retains its characteristic leaves and acorn cups. *Quercus vaccinifolia* is always a small bush—rarely much over a meter in height—and, whether in fruit or not, is distinguishable at a glance by the character of its leaves and cups. The leaves are smaller, narrower, thinner, and blunter (commonly narrowly oval with an obtuse point instead of sharply lanceolate) and lack the yellow tomentum underneath; furthermore, their margins, although somewhat thickened, are not distinctly revolute. The acorn cups are smaller and thinner, and lack the beautiful yellow 'turban' so characteristic of *chrysolepis*; the acorns average shorter and thicker and the basal scar is smaller. The branchlets are much more slender, and glabrous or nearly so, instead of tomentose.

It is remarkable that a shrub of such wide distribution, and one differing so conspicuously from the tree chinquapin (*Castanopsis chrysophylla*), should so long escape recognition as a distinct species.

Quercus californica (Torr.) Cooper. Black Oak.

[= *Q. kelloggi* Newb.]

The only oak of Shasta, where it is confined to the basal slopes of the Transition zone, reaching up on the south and west sides to an altitude of 4,500 feet. It is fairly common in McCloud Valley, more common at Sisson, and increases in abundance to the northward. Between Black Butte and Edgewood it is mixed with ponderosa pines and is one of the most conspicuous trees. It does not attain such large size in this region as nearer the coast and farther south in the Sierra.

[*Quercus garryana* was not found immediately about Shasta, and *Quercus wislizeni*, which pushes up the canyon of the Sacramento a long distance, does not fairly enter the region.]

Asarum hartwegi Watson. Wild Ginger.

Occurs here and there throughout the Transition zone, but is commonest in damp places on the lower slopes. It does not reach quite up to Wagon Camp, but in a warm lava basin on the west side of the mountain was found at an altitude a little higher than Wagon Camp.

Eriogonum marifolium T. & G. Yellow Eriogonum.

Common at Wagon Camp and other points along the lower edge of the Canadian zone and in the upper part of the Transition. The species seems to belong to the Transition rather than the Canadian zone, and Shasta is its type locality. (Identified by J. K. Small.)

Eriogonum polypodum Small. Small-leaf Alpine Eriogonum.

The commonest and most widely distributed *Eriogonum* of the higher slopes, where it ranges from the lower edge of the Hudsonian zone up to and far above timberline. The highest altitude at which it was obtained is 10,000 feet. Its leaves are small and densely covered with a white woolly or hairy material, and its tortuous prostrate branches are so intertwined as to form little mats several inches in diameter on the stony pumice slopes; these whitish mats are vastly more compact and dense above timberline than below. The roots are strong but rather slender, and, like those of many other plants that live on the barren, wind-swept pumice slopes, are of extreme length. The main root usually slopes obliquely for 80 or 90 millimeters, and then divides into four or five slender rootlets 900 to 1,000 millimeters in length. The whitish tomentose leaves rarely rise more than 25 or 30 millimeters above the ground; the fruit stems 100 to 150 millimeters.

This plant and *Polygonum shastense* are probably the most abundant, conspicuous, and widespread plants of the Hudsonian and Alpine zones. They thrive in very dry soils and therefore are not confined to the moist basins and strips bordering the streams, as are *Phyllodoce*, *Lutkea*, and many others. (Identified by J. K. Small.)

Eriogonum pyrolæfolium Hooker. Large-leaf Alpine Eriogonum.

Abundant on the pumice slopes of the Hudsonian and Arctic-Alpine zones, where it is associated with the foregoing species and with *Polygonum shastense*, *P. newberryi*, *Pentstemon davidsoni*, and others. It is easily recognized by its large roundish deep-green leaves, in striking contrast to the much smaller whitish-tomentose leaves of its congener and associate, *Erigonum polypodum.* Both species are common all the way around the mountain. The present species (*pyrolæfolium*) is rarely found above an altitude of 9,500 feet, but on a warm slope east of Mud Creek Canyon Vernon Bailey found it as high as 10,000 feet. It flowered the second time above the head of Squaw Creek the latter part of September and was then in flower and fruit simultaneously. Its root is large, thick, tapering, and moderately strong; it subdivides into about half a dozen rootlets which penetrate so deeply into the soil that it is difficult to obtain specimens without breaking them. The longest root measured was 750 millimeters to the broken end. The leaves reach about 30 millimeters above the ground; the fruit stems 70 millimeters. The old imbricating leaf stems remain attached for several years and form a series of scales around the upper part of the perennial rootstalk.

Eriogonum nudum Dougl. Naked-stem Eriogonum.

Common in the lower part of the Transition zone, particularly about Sisson, where it was flowering plentifully as late as the end of September. It is easily recognized by its tall, green naked stems, which rise from a bunch of large tomentose leaves.

Oxyria digyna (Linn.) Alpine Sorrel.

One of the characteristic alpine species, growing in cold spots among the rocks at high altitudes on all sides of the mountain; found by Vernon Bailey as high as 11,200 feet. On the north side of Shastina we collected it at 8,900 feet, and on the northeast side of Red Butte as low as 7,600 feet. This is the lowest station at which it was found, and since *Pinus albicaulis* occurs above Red Butte the locality might be mistaken to be below timberline, but the sorrel grows only among the rocks on the cold northeast slopes, where there are no trees and where the temperature is truly alpine.

Polygonum shastense Brewer. Shasta Polygonum.

One of the commonest and most characteristic plants of the stony pumice slopes of the Hudsonian and Alpine zones. A singular and attractive plant, particularly in September, when it is heavily laden with white and red flowers and fruit. As a rule the flowers are whitish, turning red as the fruit begins to develop. No two plants could well be more different in general appearance than this species and its congener and associate *Polygonum newberryi*, and few species bear a closer resemblance than *P. shastense* and its geographically remote relative *P. paronychia.* The resemblance is not only most striking, but is exceedingly interesting from the standpoint of geographic distribution. *Polygonum shastense* lives at high altitudes in the High Sierra and Cascade Range, while *P. paronychia* inhabits the outer sea beach in northern California and Oregon, where it is bathed in the chilly fogs of the Pacific Ocean. The root of *Polygonum shastense* is of moderate size and slopes very obliquely into the soil. It divides into half a dozen long slender rootlets, which penetrate to a depth of 550 millimeters or more. One specimen examined divided into three main roots of rather large size, which tapered very gradually and reached a length of 750 millimeters. The branches are prostrate and usually form loosely intertwined mats 300 to 500 millimeters in diameter, rising in some cases 40 to 50 millimeters above the surface, but usually flattened on the ground.

Polygonum newberryi Small. Broad-leaf Polygonum.

Abundant from the lower edge of the Hudsonian zone up to a little above timberline, where its big green leaves are very conspicuous on the pale pumice soil and among the broken fragments of gray lava rock. About the middle of September the leaves turn red—often a deep handsome red—and begin to fall, so that by the end of the month the plant has practically disappeared. Its buckwheat-like fruit is a favorite food of the mice inhabiting the higher slopes.

Oreobroma triphylla (Wats.) Howell. Dwarf Alpine Spring Beauty.

This tiny inconspicuous plant was found near timberline north and northwest of Red Butte. (Identified by Professor Greene.)

Spraguea umbellata Torr. Pussy-paws.

Abundant on the pumice slopes of the Hudsonian zone, beyond which it pushes both upward and downward on suitable soils. The highest altitude at which it was noted is 9,400 feet on the east side of Mud Creek Canyon, but it was rarely seen above 9,000 feet. On the other hand, a form of it descends in suitable spots to the lower edge of the Canadian zone near Wagon Camp (altitude 5,600 feet), and to the same altitude in the lower part of Mud Creek Canyon.

Stellaria crispa C. & S.

Collected by Vernon Bailey and Miss Wilkins in Mud Creek Canyon near the junction of Clear Creek. (Identified by Professor Greene.)

Sagina saginoides (L.) Brit.

Occurs above timberline; collected by Miss Wilkins.

Silene grayi Watson. Hudsonian Catchfly.

Common in stony places and along streams below timberline in the Hudsonian zone. Found both in the stony pumice soil and in the heather beds. (Identified by Miss Eastwood and Dr. B. L. Robinson.)

Silene suksdorfi Robinson.[1] Alpine Catchfly.

An alpine species common in scattered tufts, which form small compact mats under the edges of rocks, well above timberline. Often mixed with *Erigeron compositus.* (Identified by Dr. B. L. Robinson.)

Aconitum columbianum Nutt. Monkshood.

Common in a marshy place in the Shasta fir forest at Wagon Camp, where its tall wands of handsome blue flowers were conspicuous in July and its fruit in September.

Aquilegia truncata Fisch. & Mey. Red Columbine.

Common near Wagon Camp, in the upper part of the Transition zone. (Identified by Professor Greene.)

Delphinium sonnei Greene. Larkspur.

Common in moist spots in the Shasta fir forest near Wagon Camp, and also in the canyon of Ash Creek. (Identified by Professor Greene.)

Pæonia browni Dougl. Wild Pæony.

Occurs sparingly in the upper part of the ponderosa pine forest (Transition zone), particularly in the neighborhood of Wagon Camp.

Pulsatilla occidentalis Watson.

Common in places on the higher slopes (Hudsonian zone), particularly where the snow lies late. It blooms as the snow recedes, leaving a handsome globular head of feathery plumes which waves in the breeze long after the season of flowering.

Bikukulla uniflora (Kellogg) Howell.

Reported by Miss Eastwood from above timberline on Horse Camp Trail; not found by us.

Arabis platysperma Gray. Flat-pod Arabis.

The commonest and most widely distributed crucifer of the higher slopes of Shasta, where it occurs on stony slopes and along the edges of the heather beds from the lower edge of the Hudsonian zone upward on warm slopes to 10,200 feet. Its extreme vertical range appears to be about 3,000 feet. (Identified by Miss Eastwood.)

Cardamine bellidifolia pachyphylla Coville.

This small alpine crucifer, with white flowers and rather broad dark green leaves, is nowhere abundant, but was observed here and there above timberline, both on the main peak of Shasta and on Shastina. (Identified by F. V. Coville.)

Cheiranthus perennis (Coville) Greene. [=*Erysimum asperum perenne* Coville.]

Vernon Bailey and I found this coarse yellow-flowered crucifer at timberline on the north slope of Shastina July 24, but did not observe it elsewhere. (Identified by Professor Greene.)

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[1] Botanical Gazette, vol. 16, p. 44, pl. 6, 1891.

Draba breweri Wats. Sierra Alpine Draba.

Collected east of Mud Creek Canyon at an altitude of 13,000 feet by Miss Wilkins; not observed elsewhere. This *Draba* and *Polemonium pulchellum* are the only plants found at so great an elevation. (Identified by F. V. Coville.)

Streptanthus orbiculatus Greene.

A Hudsonian species common on pumice soil in stony places at and below timberline all the way around the mountain. The plant is easily recognized by its long curved slender pods and its rather large domed leaves. The length of the large tapering root only slightly exceeds the height of the plant. (Identified by Professor Greene.)

Chrysamphora californica (Torr.) Greene. California Pitcher Plant. (=*Darlingtonia* Auct.)

This interesting pitcher plant is exceedingly local in distribution. Mr. Elmer Applegate tells me that it is common in the upper part of the Sacramento Canyon, a short distance from Sisson Tavern. It has been reported as occurring in the 'marshes' of Shasta, but we did not find it on the mountain, nor did we find any marshy areas more than a few rods in extent.

Drosera rotundifolia Linn. Sundew.

Collected by Miss Wilkins in the springy bog just above Wagon Camp in the Canadian zone. Not observed elsewhere.

Mitella pentandra Hook.

Common in the heather patches along the overhanging banks of streams in the Hudsonian zone. Abundant at Squaw Creek Camp. (Identified by Professor Greene.)

Parnassia californica (Gray) Greene. Grass-of-Parnassus.

This elegant flower is common along the water courses of the Hudsonian zone, usually growing along the overhanging banks of the tiny rivulets. It blossoms late, and a few plants were still in flower when snow fell, the last week in September.

Saxifraga bryophora Gray.

Reported by Miss Eastwood from the timberline region on Horse Camp Trail; not found by us.

Saxifraga tolmiei[1] T. & G. Alpine Rock Saxifrage.

Common above timberline, where it usually forms small dense mats in moist places among rocks. On Inconstance Creek, on the north side of Shasta, it was found as low as 7,600 feet. On the south slope it ranges up to 11,000 feet, or possibly higher. On the cold northeast side of Red Butte it occurs among the rocks with *Oxyria digyna*. (See p. 50.)

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[1] The spelling *tolmæi* should be regarded as an obvious typographical error.

Peltiphyllum peltatum (Torr.) Engler. Giant Water Saxifrage.

One of the most conspicuous plants in the bottom of the Sacramento Canyon, where its clusters of huge incised roundish leaves along the water's edge suggest the devil's club. It ranges along the Sacramento River from just below Sisson nearly to the Sacramento Valley.

Ribes amictum Greene.

Occurs at Wagon Camp, along Squaw Creek, and in the bottom of Mud Creek Canyon at an altitude of 6,700 feet. (Identified by Professor Greene.)

Ribes cereum Dougl.

Found near timberline near the head of Panther Creek, and also much lower down.

Ribes viscosissimum Pursh.

Common near Wagon Camp and observed at other points within the Transition zone, particularly along Squaw Creek.

Ribes klamathense Coville.

Occurs in cool moist places in the Transition zone at Sisson. (Identified by F. V. Coville.)

Cercocarpus ledifolius Nutt. Mountain Mahogany.

Common on Sheep Rock and thence to the southeastern corner of Shasta Valley (V. Bailey), and on warm, dry slopes of the Scott Mountains, where *C. parvifolius* also occurs.

Fragaria bracteata Heller. Small Strawberry.

Common on the lower slopes. Just below Wagon Camp strawberries and painted cups are so abundant as to form an almost continuous carpet under the uppermost grove of ponderosa pines. (Identified provisionally by P. A. Rydberg.)

Fragaria chiloensis Duchesne. Large Strawberry.

Occurs with the last a little below Wagon Camp, but is much commoner lower down, particularly near Sisson. Sisson Tavern was formerly called 'Berryvale' and is located in 'Strawberry' Valley. Both names were derived from the abundance of this wild fruit there in early days. (Identified provisionally by P. A. Rydberg.)

Holodiscus discolor (Pursh) Maxim. Alpine Spiræa.

Common on rocks at and a little below timberline, usually associated with *Pinus albicaulis*. It is a small, fragrant bush, usually less than a foot in height, and always grows among rocks at high altitudes. In the Hudsonian zone it was found all the way around the mountain, and was in blossom from about July 20 until September. A larger form, which the botanists do not appear to have named, occurs lower down, in the Canadian zone. It has larger, broader, and thinner leaves and should be separated.

Spiræa douglasi Hook. Red Spiræa.

Common in moist places in the Canadian and Transition zones, but most abundant in the latter. It is common at Sisson, at the west base of the mountain, and in Squaw Creek Valley on the south side, and thence upward, in suitable moist spots, to Wagon Camp at 5,700 feet, along Squaw Creek at 6,000 feet, and in Mud Creek Canyon as high as 6,700 feet.

Horkelia pseudocapitata Rydberg.

Abundant in the Transition zone near Wagon Camp, particularly about the upper limit of *Pinus ponderosa.* (Identified by P. A. Rydberg.)

Kunzia tridentata (Pursh.) Spreng.

Irregularly distributed in the Transition zone; commonest in the manzanita chaparral of the lower slopes. On the north side of the mountain it is exceedingly abundant, and in the open pine forest bordering the south end of Shasta Valley attains unusually large size. On the west side, north of Sisson, it occurs sparingly on most of the warmer and drier knolls, and more plentifully between Black Butte and Shasta Valley. It is almost always associated with *Arctostaphylos patula*, with which it ascends some of the warmer slopes to points far above the upper limit of its usual distribution. Thus it was found on a southwest slope in Mud Creek Canyon between the altitudes of 6,700 and 7,400 feet; on similar slopes near Horse Trail and in Diller Canyon as high as 7,800 to 7,900 feet, and on a warm pumice ridge north of Shastina at 7,500 feet.[1] In Squaw Creek Valley, near McCloud Mill, a form occurs which has exceedingly narrow leaves.

Lutkea pectinata (Hook.) Kuntze.

Abundant in the Hudsonian zone, chiefly in the neighborhood of timberline, where it is common along the little streams in the upper edge of the forest, and in the glacial basins which are wet from melting snows in the early part of the season, but may be dry at the time the plant blossoms. In damp spots, particularly along the borders of cool springs, the individual plants often stand so near together as to form extensive beds.

Potentilla flabellifolia Hook.

Occurs here and there, a little below timberline, in the Hudsonian zone. (Identified by Miss Eastwood and P. A. Rydberg.)

Potentilla pseudorupestris Rydberg. Dwarf Alpine Potentilla.

A dwarf Alpine or high Hudsonian *Potentilla* of the *glandulosa* type, collected on the north side of Shastina at an altitude of about 8,800 feet, is provisionally referred to this species by Mr. Rydberg.

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[1] For an explanation of this seemingly abnormal range, see p. 49.

Potentilla glandulosa Lindl. Large Yellow Potentilla.

A large *Potentilla* from the Transition zone, near Wagon Camp, is identified by Mr. Rydberg as *P. glandulosa.*

Rosa californica C. & S. California Rose.

Abundant in moist places in the Transition zone near Sisson Tavern and along the east base of Mount Eddy.

Rosa gymnocarpa Nutt. Wild Rose.

Common in places in the Transition zone, particularly a little below Wagon Camp.

Rubus parviflorus Nutt. [=*R. nutkanus* Auct.] Western Thimbleberry.

Common in cool moist places in McCloud Valley and at Sisson, and thence up through the Transition zone to an altitude of 5,200 feet on the road to Wagon Camp, and 6,000 feet along Squaw Creek and in Mud Creek Canyon. Most of the Transition slopes of Shasta are too dry for the thimbleberry.

Rubus vitifolius C. & S. Blackberry.

Common in cool moist places in the Transition zone near Sisson and along the east base of the Scott Mountains.

Sibbaldia procumbens Linn. Alpine Sibbaldia.

Common in the Hudsonian zone near timberline, particularly in springy places and in the heather beds. Usually occurs in small patches below extreme timberline.

Amelanchier alnifolia Nutt. Serviceberry.

Abundant in moderately moist parts of the Transition zone. On the west and southwest sides of the mountain it reaches from Sisson to Wagon Camp. On a warm southwest slope on the steep ridge between Mud Creek Canyon and Clear Creek it occurs, with several other Transition zone species, at the unusual altitude of about 7,000 feet. (See p. 49.)

Cratægus rivularis Nutt. Black Haw.

Common in the Transition zone about the west base of Shasta, particularly along streams at the east base of Mount Eddy, from the head of the Sacramento northward, usually in cool moist soil. Common near Sisson Tavern.

Sorbus sambucifolia (C. & S.). Mountain Ash.

Rather scarce and confined chiefly to the relatively moist Transition zone slopes of the canyons. In Mud Creek Canyon it was found along the bottom from 5,600 feet to 6,700 feet. Along Squaw Creek it was found at about 5,500 feet.

Cerasus demissa (Nutt.). Western Chokecherry.

Common in places in the lower part of the Transition zone. Observed on the south slope above McCloud Mill, mainly in the gulches; also in the neighborhood of Sisson, and near the south end of Shasta Valley.

Cerasus emarginata Dougl. Bush Cherry; Bitter Red Cherry.

Abundant in places in the chaparral of the Transition zone. In Sacramento Canyon, south of Shasta, it begins at 'The Loop,'[1] and ranges up to the lower edge of the Canadian zone. It is profusely abundant at Wagon Camp, where it is a straggling bush a little higher than a man's head, and usually grows in thickets. It ascends Mud Creek Canyon to an altitude of 5,600 or 5,700 feet.

Cerasus glandulosa Kellogg.

A sapling or small tree having large broad leaves; collected by me a short distance south of Sisson Tavern. (Identified by Professor Greene.)

Prunus subcordata Benth. Wild Plum.

Common in places along the southern and western borders of Shasta Valley, usually in the edge of the open *Pinus ponderosa* forest and often growing with *Rhus* and *Kunzia*. We found it also near Etna, on the west side of Scott Valley.

Cercis occidentalis Torr. Red-bud.

Reported from Mount Shasta in the Botany of California, but not found by us except in the Sacramento Canyon, where it is common.

Lotus americanus (Nutt.) Bisch. [= *Hosackia americana.*]

Common in the Transition zone at Wagon Camp, and thence along the road to Sisson, growing chiefly in open places in the chaparral.

Lupinus elmeri Greene [= *L. albicaulis sylvestris* Auct.]

Common in places throughout the upper part of the Transition zone, and ranging into the Canadian. Common at Wagon Camp and a little above. Found also in Mud Creek Canyon at mouth of Clear Creek. (Identified by J. B. Leiberg.)

Lupinus 'ornatus' Auct. [not of Douglas.] Silvery Lupine.

This beautiful species is common in spots near and a little below timberline, sometimes covering extensive areas, but not uniformly distributed. Where it occurs it is usually sufficiently abundant to give the mountain side the effect of a distinct silvery covering. It always grows on stony or pumice slopes and usually among or near white bark pines, although in a few instances it was found outside of the pine areas. It is common near the head of Squaw Creek and on both sides of Mud Creek Canyon. On the east side of this canyon it is particularly abundant just above the trees, and stops abruptly at an altitude of 8,200 to 8,400 feet, to be replaced by the dwarf Alpine *L. lyalli*. On the north side of Shasta it is common in an open forest of white-bark pines in a shallow gulch at the east base of the lava buttes just below 'North Gate.' The upper limit of the silvery lupine usually coincides with the lower limit of the dwarf lupine (*L. lyalli*), which species generally pushes from this point upward through the Alpine zone.

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[1] In this and subsequent references to 'The Loop' the statement means that in going north along the railroad track we first saw the plant at 'The Loop.' The species may occur farther south in the canyon on suitable slopes above the level of the railroad.

The root of the silvery lupine is slender and tough, and soon divides into two or three very long wire-like rootlets which run a rather shallow course in the sand. Some of them measure 750 millimeters. The plant at timberline averages about 60 millimeters in height.

Mr. Leiberg tells me that this species, although commonly referred to '*ornatus*', is not *ornatus* of Douglas. It has also been called *L. argenteus decumbens* Watson.

Lupinus albifrons Benth.

Collected near Horse Camp August 20 by Vernon Bailey and Miss Wilkins. (Identified by J. B. Leiberg.)

Lupinus lyalli Gray. Dwarf Alpine Lupine.

Abundant and widely distributed over the higher rocky pumice slopes from timberline or a little above up to an altitude of slightly more than 10,000 feet. (Identified by J. B. Leiberg.)

Lupinus minimus Dougl. Dwarf Lowland Lupine.

Common in the Transition zone at Sisson. (Identified by J. B. Leiberg.)

Vicia americana Muhl.

Rather common at and below Wagon Camp, and still in flower when we left, September 25.

Linum lewisi Pursh. Wild Hemp.

Abundant at Wagon Camp, where its delicate blue flowers were conspicuous in July, and its large subglobular seed capsules in September.

Polygala cornuta Kellogg.

Occurs plentifully in the dry pine woods of the Transition zone near Sisson Tavern, but was not observed on the mountain proper. (Identified by Miss Eastwood.)

Rhus trilobata Nutt.

In going north from Sisson we first observed this species a mile or two south of Edgewood, to the north and east of which it became more and more common. Its zone position here is along the borderland between the Transition and Upper Sonoran zones.

Pachystima myrsinites Raf. Oregon Boxwood.

Common in the Transition zone at the west base of Shasta, from Sisson up to an altitude of about 4,700 feet, usually in manzanita chaparral. Its absence from the higher slopes within the proper zone limits of the species is probably due to heat and dryness, as explained elsewhere (p. 56), but it is possible that the Sisson plant is a Transition zone subspecies of the true Boreal *P. myrsinites*.

Acer macrophyllum Pursh. Oregon Maple; Big-leaf Maple.

The tree maple is rare in the region about Shasta, where it was observed only in moist places in the lower part of the Transition zone near Sisson and in the upper part of the Sacramento Canyon.

Acer glabrum Torr. Bush Maple.

Fairly common in McCloud Valley and in moist places along streams and canyons in the Transition zone. In Mud Creek Canyon it was found up to an altitude a little above 5,600 feet, and along Squaw Creek to nearly 6,000 feet.

Acer circinatum Pursh. Vine Maple.

This characteristic west-coast species, with nearly circular 7-point leaves, occurs sparingly in moist places near Sisson Tavern, but is not common. It is one of the most distinctive plants of the humid Pacific coast division of the Transition zone.

Ceanothus cordulatus Kellogg. Snow Bush.

Common in the lower part of the Transition zone on the southern and western basal slopes of Shasta. In the upper part of Sacramento Canyon it first occurs at 'The Loop,' whence it is abundant northerly to within a mile or two of Edgewood. At Sisson and in Squaw Creek and McCloud valleys it is very abundant, but for some reason not apparent it does not reach on Shasta its usual upper limit, and was not observed anywhere above 4,900 feet. Possibly it is choked out by the other chaparral, which is made up mainly of manzanita (*Arctostaphylos patula*) and buck-brush (*Ceanothus velutinus*).

Ceanothus cuneatus Nutt. Wedge-leaf Ceanothus.

This is one of the most characteristic shrubs of the Upper Sonoran zone in California, where it is generally associated with the curious digger pines. The region about Shasta is too high for it. It occurs, however, in the lower valleys, both north and south of Sisson. On the north it reaches from Yreka to a little beyond Edgewood, appearing a mile or two south of the latter point on the road to Sisson, and about 4 miles southwest of it on a road farther west. Skipping the broad Transition belt between Edgewood and the Sacramento, it occurs next at Delta, in the Sacramento Canyon, and ranges thence southerly. Its upper border meets the lower border of another species, *C. cordulatus*, which is common at Sisson, as well as on the southern and western basal slopes of Shasta.

Ceanothus velutinus Dougl. Buck-brush.

Profusely abundant on all the manzanita-covered slopes of Shasta, from the lower part of the Canadian zone down nearly to the lower edge of the Transition. Mixed with *Arctostaphylos patula* in nearly equal proportion it forms the dominant chaparral of the mountain.

Tongues of it push up on warm southerly slopes to about 6,600 feet[1] altitude, and it descends on the west slope to about 4,200 feet (half a mile east of Sisson), and on the south slope to 3,600 feet (near McCloud Mill). Along the east base of Mount Eddy, where it is sheltered from the afternoon sun, it appears about 2 miles north of Sisson (altitude 3,700 feet), and continues northerly for many miles.

Ceanothus integerrimus H. & A. California Lilac.

Common in parts of the Transition zone, notably in Squaw Creek Valley near McCloud Mill, and in the upper Sacramento Valley a little below Sisson, but very scarce or absent on the slopes of Shasta proper. Like *C. cordulatus* it seems to be kept out by some unknown cause, possibly choked out by other species. Perhaps the soil is too dry for it.

Ceanothus (Cerastes) prostratus Benth. Squaw Carpet.

In following the Sacramento Canyon northward, Squaw Carpet was first seen at the 'The Loop,' a few miles south of Sisson, whence it occurs in greater or less abundance throughout the ponderosa pine forest and manzanita chaparral to the lower slopes of Shasta, where on the southwest side it reaches up to 5,200 feet.

Rhamnus californica Esch. (This form may be *R. rubra* Greene.)

Scarce and confined to low altitudes in the Transition zone. Found by Vernon Bailey in Squaw Creek Valley below 4,000 feet. Specimen lost.

Hypericum anagalloides C. & S. Dwarf Hypericum.

Common in spots in wet places in the Hudsonian and Canadian zones. It was most common in the second meadow on Squaw Creek, and by no means rare near Wagon Camp, and was in flower in late July and throughout August.

Viola blanda Willd. White Violet.

Collected by Miss Wilkins in the middle meadow on Squaw Creek, at an altitude of 7,500 feet. Not observed elsewhere.

Viola purpurea Kellogg. Alpine Yellow Violet.

Common on dry rocky slopes on pumice soil from some distance below timberline upward, on warm southerly exposures, to 9,300 feet. When we reached the mountain, the middle of July, its yellow flowers were conspicuous, although even at that time the species had nearly passed flowering. Its fruit and dark green leaves remained as late as the latter part of September, sharply outlined against the whitish stones and pumice of the bleak and barren upper slopes, where a violet seemed singularly out of place. (Identified by Miss Eastwood and Professor Greene.)

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[1] For its extreme upper limit, on hot canyon slopes, see remarks under *Arctostaphylos patula*, p. 158.

Mentzelia lævicaulis (Dougl.) T. & G.

Rather common in Shasta Valley, but not found elsewhere about the mountain. This species seems to belong to the Upper Sonoran zone, and therefore has no place in the flora of Mount Shasta.

Epilobium spicatum Lamarck. Willow Herb; Fire-weed.

Abundant in places, chiefly on old burns in the Canadian and Transition zones. At Wagon Camp it did not begin to flower until near the middle of August; at Sisson it was still in flower in places as late as the middle of September.

Epilobium brevistylum Barbey.

Collected at Wagon Camp, where it is tolerably common in moist places; the largest species next to *spicatum.* (Identified by Professor Trelease.)

Epilobium oregonense Hausskn.

Common at Wagon Camp. A large form occurring also at Wagon Camp Professor Trelease considers as probably *E. glaberrimum* Barbey.

? **Epilobium hornemanni** Reichenb.

Some poor specimens, with exceedingly long seed capsules, collected by me a little below timberline about the end of the season, are doubtfully referred to this species by Professor Trelease.

Epilobium clavatum Trelease.

Abundant in the heather meadows and along the edges of the cool streams of the Hudsonian zone at and a little below timberline. (Identified by Professor Trelease.)

Epilobium pringleanum Hausskn.

A tiny alpine species, rarely as tall as one's thumb, occurring here and there on the borders of the highest streamlets above timberline. (Identified by Professor Trelease.)

Epilobium obcordatum Gray. Rose Epilobium.

Local—common near timberline on the steep west side (east slope) of Mud Creek Canyon. A remarkable plant, strikingly unlike the others of its genus. It has a woody base and is really a dwarf bush. Its large red flowers are showy and very handsome. (Identified by Miss Eastwood and Professor Trelease.)

Gayophytum ramosissimum T. & G.

Abundant throughout the Transition zone, where it was equally common at Sisson and at Wagon Camp and was in flower as late as the end of September. (Identified by Miss Eastwood.)

Carum gairdneri (Hook. & Arn.) Gray.

Rather common in damp soil at Wagon Camp where the Canadian and Transition zones meet. (Identified by Dr. J. N. Rose.)

Cymopterus terebinthinus T. & G.

Common in the neighborhood of timberline, usually in stony places on dry pumice slopes; found also on top of Red Cone, a little east of Wagon Camp. This species has a large and woody root and a remarkably rank and lasting odor. Its zone position is Hudsonian; a larger unrecognized form occurs in the Canadian zone. (Identified by Miss Eastwood and Dr. Rose.)

Ligusticum grayi Coulter & Rose.

Common throughout the Hudsonian zone, particularly a little below timberline, where it occurs most abundantly in the beds of heather along the little streams. In places it pushes down into the Canadian zone. (Identified by Miss Eastwood and Dr. Rose.)

Heracleum lanatum Michx. Cow Parsnip.

Occurs in damp places in the Canadian zone. In Mud Creek Canyon near the mouth of Clear Creek it was found as high as 6,700 feet. (Identified by Dr. Rose.)

Osmorrhiza nuda Torr.

Found sparingly at Wagon Camp and at Sisson.

Cornus nuttalli Audubon. Oregon Dogwood.

Rather common in moist places in the lower half of the Transition zone. It occurs in Squaw Creek Valley near McCloud Mill, and is common along the streams near Sisson Tavern; on the road from Wagon Camp to Sisson it was seen up to an altitude of 4,500 feet.

Cornus pubescens Nutt.

Common in cool damp soil near Sisson and along the upper Sacramento.

Chimaphila umbellata (L.) Nutt.

Occurs here and there throughout the drier parts of the forest, but is less common than *Chimaphila menziesi.*

Chimaphila menziesi Spreng.

Fairly common throughout the Shasta fir forest, and also in the mixed forest of pines and firs from the upper Sacramento Canyon northward (Canadian and Transition).

Pyrola picta Smith.

Occurs here and there throughout the forest of Shasta firs, where its ornamental light-marbled leaves are pleasingly conspicuous against the dark soil.

Pyrola pallida Greene.[1]

Found sparingly on the dry summit of Red Cone, about a mile east of Wagon Camp. (Identified by Professor Greene.)

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[1] Pittonia, IV, p. 39, March 17, 1899.

Pyrola secunda Linn.

Decidedly less common than *P. picta*, but like it found in the Shasta fir forest.

Pterospora andromedæ Nutt. Pinedrops

Found in the dry woods along the border between the Canadian and Transition zones. (Identified by Professor Greene.)

Pleuricospora fimbriolata Gray.

Collected at Wagon Camp by Miss Wilkins. (Identified by F. V. Coville.)

Sarcodes sanguinea Torr. Snow Plant.

This handsome plant is reported as common on the forested slopes of Shasta at the time of melting snow in spring. It probably occurs in both the Canadian and Transition zones.

Arctostaphylos nevadensis Gray. Dwarf Mountain Manzanita.

Common in the Canadian and Hudsonian zones, growing in extensive beds a foot or less in height. On the high ridges, among the timberline *Pinus albicaulis*, these beds of green cover the pale gray lava rocks, and in the dark forests of Shasta fir they form the only conspicuous surface vegetation.

Arctostaphylos patula Greene. Green Manzanita.

The most abundant and troublesome chaparral of Shasta. It is a characteristic Transition zone species and covers the lower slopes all the way around the mountain except a belt about 10 miles wide on the northeast base, reaching from Ash Creek to about 3 miles northwest of Inconstance Creek, which is too cold for it and is occupied by Canadian zone species. On the north, west, and south it covers practically the whole of a broad belt several miles in width, reaching from base level

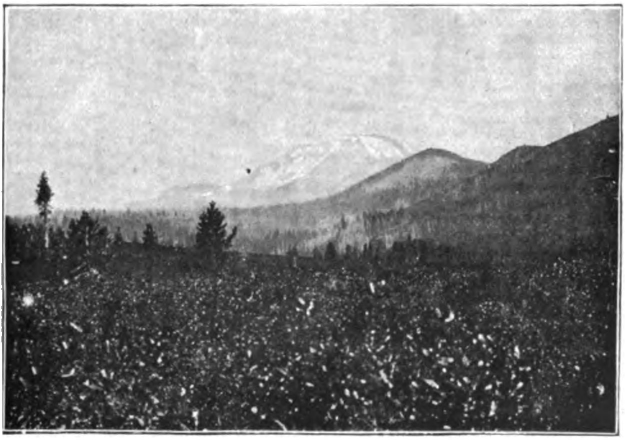

FIG. 45.—Manzanita chaparral.

to the lower edge of the Canadian zone and formerly occupied in the main by a forest of ponderosa pines, some of which still remain scattered over it. Except at its extreme lower limit, it is usually mixed with buck-brush (*Ceanothus velutinus*).

Seen from a distance, the extensive areas of manzanita on the lower slopes of Shasta are very deceptive. They look like meadows of green grass, but to cross them is in most cases impossible, owing to the density of the growth and rigidity of the branches. For this reason they form secure retreats for black bears, deer, wild-cats and other animals.

At two places on the west side of the mountain *Arctostaphylos patula* reaches the extraordinary altitude of 7,800 to 7,900 feet. One of these is on the north side of Diller Canyon, the other on the north side of Horse Camp Trail. Both stations are on long and steep southwest pumice slopes which receive the hot rays of the afternoon sun almost at a right angle, carrying up numerous Transition zone species nearly 2,000 feet above their normal limit. (See p. 51.) From the southwest base of Shasta the green manzanita reaches down the canyon of the Sacramento River to 'The Loop.'

Phyllodoce empetriformis (Gray). Red Heather.

[=*Bryanthus empetriformis* Auct.]

Abundant along the cold streams of the Hudsonian zone and in the bottoms of the glacial basins that are kept moist by melting snows; commonest between the altitudes of 7,500 and 8,500 feet, and not seen above 9,100 feet. This is the only 'heather' found on Shasta. It usually forms extensive beds or carpets in which numerous other plants find a congenial home. These beds are practically the only flower gardens on the mountain, and the only areas where small plants are plentiful enough to give the effect of continuous green; hence they are commonly spoken of as 'heather meadows.'

Kalmia glauca microphylla Hook. Alpine Laurel.

Abundant in most of the heather meadows just below timberline, particularly along Squaw Creek. In general size and aspect the alpine laurel resembles the red heather so closely that at a little distance it is difficult to tell them apart.

Vaccinium cæspitosum Mich. Dwarf Alpine Blueberry.

Abundant on the higher slopes within the Hudsonian zone, reaching a little above timberline. Common here and there in the stony pumice flats and basins, but commonest near the streams, where it is scattered through the heather and forms beds of its own along the outer edges of the heather beds. Its leaves turn dark red or garnet during the latter half of September, contrasting handsomely with the dark green of the heather. In the neighborhood of timberline the dwarf blueberry is rarely more than three or four inches in height. It was in full bloom the middle of July.

The form here referred to is the dwarf High Sierra one, given under *cæspitosum* by Coville, in his 'Botany of the Death Valley Expedition' (p. 145, 1893).

Vaccinium arbuscula (Gray) [= *Vaccinium cæspitosum* var. *arbuscula* Gray].

Common in moist places in the Transition zone from Wagon Camp down to Warmcastle Soda Springs at the south base of the mountain. This species seems to be distinct from the dwarf boreal *V. cæspitosum.* It averages about 2 feet (60 centimeters) in height and has red branches and decidedly larger and thicker leaves than the alpine *cæspitosum.* Whether or not the latter is the typical form is another question. The zone position of *V. arbuscula* is probably Canadian and Transition.

Vaccinium occidentale Gray. Blueberry.

Common in the Canadian zone in some of the canyons, and in the marsh at Wagon Camp, where it fruited early.

Fraxinus oregana Nutt. Oregon Ash.

Occurs sparingly in the upper Sacramento Canyon, but was not observed about the actual base of the mountain.

Gentiana simplex Gray. Blue Gentian.

Common in the Canadian zone swamp at Wagon Camp the first half of August. (Identified by Professor Greene.)

Apocynum pumilum (Gray) Greene.

Common in suitable places throughout the Transition zone, from which it pushes up a short distance into the lower edge of the Canadian. With other Transition zone species it was found on a warm slope in Mud Creek Canyon at 6,700 feet. (Identified by Professor Greene.)

Cycladenia humilis Benth.

Common in places in the Hudsonian zone, but very local. It occurs plentifully on the top of Red Cone, a short distance northeast of Wagon Camp, at an elevation of about 6,600 feet; on a red lapilli hill which forms a part of Red Butte, just east of 'The [South] Gate,' and on both sides of Mud Creek Canyon a little below true timberline. The highest altitude at which it was observed was 8,700 feet on a southwesterly slope on the west side of Mud Creek Canyon. *Cycladenia humilis* is a curious and rather striking plant. It usually has four large entire leaves, suggesting those of *Polygonum newberryi*, and bears a pair of conspicuous red tubular flowers followed by two curious seed pods, which are very long and lie side by side, one above the other, like the barrels of a Winchester rifle. (Identified by Miss Eastwood.)

Gilia aggregata (Pursh) Spreng.

Common throughout the ponderosa pine forests of the Transition zone and sometimes seen in the lower part of the Shasta fir forest, where its handsome scarlet flowers are very attractive. On warm southwest slopes near Panther Creek it was found as high as 6,600 feet, and between Mud and Clear creeks as high as 6,700 feet, but these are abnormal altitudes due to unusually warm exposures and soil.

Collomia grandiflora Dougl.

Common in the upper part of the Transition zone a little below Wagon Camp, where it was flowering abundantly the last half of July.

Phlox douglasi diffusa (Benth.) Gray. Alpine Phlox.

A common, widely distributed, and conspicuous plant of the higher slopes within the Hudsonian zone, sometimes straggling down into the Canadian zone. It occurs in scattered tufts on the dry rocky slopes and ridges, usually on pumice soil, and is commonest in the neighborhood of timberline. It blossoms early, and flowers were rarely seen as late as the latter part of July. After flowering the whole plant withers and is disintegrated by the wind, so that little more than the woody base remains.

Polemonium pulchellum Bunge.

A characteristic but not abundant Alpine species, occurring here and there among rocks far above timberline. On the north side of Shastina it was in full bloom July 24 at an altitude of 8,900 feet. On the south side of Shasta, above Squaw Creek, and on both sides of Mud Creek Canyon, it was not found below 9,500 feet, whence it ranges up to 13,000 feet. This species and *Draba breweri* were both observed at 13,000 feet, and are the highest plants found on Shasta. (Identified by Professor Greene.)

Phacelia frigida Greene.[1] Dwarf Alpine Phacelia.

This new species, which Professor Greene has kindly described at my request from specimens collected by us above the head of Squaw Creek, is common and widely distributed on the higher and more barren rocky slopes, beginning above timberline and reaching, on southerly slopes, as high at least as 10,200 feet. The lowest altitude at which it was found is 8,700 feet, on a cold slope.

Phacelia magellanica (Lam.) Coville.

A plant which, in the present unsatisfactory state of the group, it seems necessary to refer here, is abundant on the lower slopes, particularly in the Transition zone, where it was in flower throughout the summer and as late as the end of September.

Cryptanthe geminata Greene.

Rather common in the Transition zone below Wagon Camp. (Identified by Professor Greene.)

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[1] Pittonia, IV, pp. 39–40, March 17, 1899.

Lappula nervosa (Kellogg) Greene.

Abundant in the openings near and a little below Wagon Camp, where it is the most troublesome 'stick-tight' of the region, filling the forelocks and manes of the horses and binding them together in a dense mat.

Monardella odoratissima Benth.

Abundant in the Canadian zone and much less common in the Hudsonian. Abundant in the chaparral at Wagon Camp and found in several places on warm sunny slopes as high as 7,800 or 7,900 feet, and in one place near the head of Squaw Creek at 8,300 feet. In the latter locality only a few bunches occur among the rocks and no others were observed for a long distance below.

Scutellaria nana Gray. Dwarf Skullcap.

This interesting little yellow-flowered skullcap was found at one place only—the north slope of Shastina, at an altitude of 8,800 feet, where it was flowering July 24. If this alpine plant is the same as the type of *S. nana*, which came from the hot desert region near Pyramid Lake, Nevada, its occurrence at timberline on Shasta must be accidental. (Identified by F. V. Coville.)

Stachys ingrata Greene.

Abundant in moist soil at Wagon Camp, on the border between the Canadian and Transition zones. (Identified by Professor Greene.)

Chamæsaracha nana Gray.

This solanaceous plant, which has la ge white flowers and looks like a dwarf potato, is common in an old burn near Wagon Camp, where the Canadian and Transition zones overlap. (Identified by Miss Eastwood.)

Castilleja miniata Dougl. Scarlet Painted Cup.

Common and conspicuous. A large form, probably the type form—since the type came from the Blue Mountains of Oregon—is common in moist places in the lower part of the Canadian zone and upper part of the Transition. It was flowering abundantly in the uppermost grove of ponderosa pines at Wagon Camp the latter half of July. A smaller form, apparently unnamed, abounds in the heather beds of the Hudsonian zone near and a little below timberline, where it was flowering profusely the first half of August.

The scarlet painted cup is one of the handsomest flowers of the mountain. Where the plants are abundant on the dark heather the effect of the bright green corolla tubes protruding in slender spindles from the vivid scarlet mass of bracts and calyx is superb. Early in August the calliope hummingbirds were constantly hovering over these flowers. (Identified by M. L. Fernald.)

Castilleja affinis Hook. & Arn.

A plant collected in the Hudsonian zone near timberline just north of Red Butte by Vernon Bailey has been identified as this species by M. L. Fernald. Since the type locality of *affinis* is the low coast strip near San Francisco or Monterey, the typical form would hardly be expected to occur in the high timberline region of Shasta.

Orthocarpus pilosus Watson.

Common in places near timberline, particularly near 'The [South] Gate,' between the heads of Panther Creek and Squaw Creek. (Identified by M. L. Fernald.)

Mimulus implexus Greene.

Abundant in wet places throughout the Hudsonian zone, reaching its greatest perfection in the neighborhood of timberline. In the shallow rapids of some of the mountain rivulets it grows in such profusion that its leaves form extensive mucilaginous patches, which completely fill the beds of the streams. Its large and showy yellow flowers were in blossom from the latter part of July until the end of September. (Identified by Professor Greene.)

Mimulus moniliformis Greene.

Two forms of large yellow *Mimulus* grow in the marsh at Wagon Camp, in the lower edge of the Canadian zone. (Identified by Professor Greene.)

Mimulus tilingi (Regel.) Greene.

Common in the marsh at Wagon Camp. (Identified by Professor Greene.)

Mimulus primuloides Benth.

Common in patches in marshy places and along streams in the Canadian and Hudsonian zones, but much more common in the Canadian than in the Hudsonian. It was abundant at Wagon Camp and also in some of the heather meadows along Squaw Creek and other streams. (Identified by Miss Eastwood and Professor Greene.)

Pentstemon menziesi Hook.

One of the most characteristic and widely distributed plants of the higher slopes, where it is common among the bare rocks all the way around the mountain. It is common in the Hudsonian zone in the neighborhood of timberline, but much more abundant in the Alpine, and was found by Vernon Bailey as high as 10,200 feet. This species is easily distinguished from the other Alpine species of the region by its smooth entire leaves and relatively small bluish or violet blue flowers, which become pink or reddish with age. (Identified by Professor Greene.) The plant is by no means typical, but seems to be intermediate between *menziesi* and *davidsoni*. It may be a distinct species.

Pentstemon newberryi Gray.

Common in places in the Hudsonian zone and possibly in the upper part of the Canadian; much less generally distributed than *P. menziesi* and usually occurring at lower altitudes. On the north side of Shastina it was flowering, the latter part of July, at an elevation of 7,600 feet, and at the same time on the cold east slope of Mud Creek Canyon as low down as 5,600 feet. Its flowers are much larger than those of *P. menziesi* and red instead of bluish; its leaves are longer, and are serrate instead of entire.

Pentstemon glaber utahensis Watson.

Abundant just below timberline on the curious *Pinus albicaulis* plain between North Gate and Bolam Creek, on the north side of Shasta, where it was flowering plentifully July 24. It was not seen elsewhere on the mountain. Its blue-purple flowers are even larger than those of *P. newberryi* and are very showy and handsome. (Identified by Professor Greene.)

Pentstemon deustus (Dougl.). Yellow Pentstemon.

Common in the rough black lava beds in the Shasta fir forest north of Cascade Gulch, on the west side of the mountain, at an altitude of about 7,500 feet, but not seen elsewhere. This species is a dwarf bush 5 or 6 inches high, with yellow flowers and strongly serrate leaves. (Identified by Professor Greene.)

Pentstemon gracilentus Gray.

Abundant in places in the Shasta fir forest, particularly between the canyons of Mud and Ash creeks, in the Canadian zone. (Identified by Miss Eastwood and Professor Greene.)

Pentstemon confertus Dougl. (Not typical.)

Common near Wagon Camp. (Identified by Miss Eastwood and Professor Greene.)

Veronica cusicki Gray.

Common just below timberline, particularly along the little streams where it grows in the grass and heather on the overhanging banks. It was flowering abundantly from the time of our arrival, the middle of July, until about the middle of August. (Identified by Miss Eastwood and Professor Greene.)

Boschniakia strobilacea Gray.

Collected at Wagon Camp by Miss Wilkins. (Identified by Professor Greene.)

Linnæa borealis Linn. Twin Bell-flower.

Fairly common along one of the streams half a mile north of Sisson Tavern, but not noticed elsewhere. This form was described by Torrey as variety *longiflora*.

Sambucus melanocarpa Gray. Blackberry Elder.

Common in moist parts of the Transition zone, particularly in the canyons. (Identified by Professor Greene.)

Symphoricarpos racemosus Mich. Snowberry.

Common about Sisson Tavern and in cool moist places along the base of Mount Eddy.

Symphoricarpos pilosus Greene. Mountain Snowberry.

Abundant in the upper part of the Transition zone, particularly at Wagon Camp and along Squaw Creek. (Identified by Professor Greene.)

Campanula wilkinsiana Greene.[1] Shasta Bluebell.

This new bluebell, recently described by Professor Greene from specimens collected by us on the upper part of Squaw Creek, is common in the lower heather meadows, and less so in the marshy place at Wagon Camp. It is singular that the only *Campanula* found on Shasta should be new, the usual Sierra and Cascade species being absent. The present species, which is named after Miss Lewanna Wilkins, averages 4 to 5 inches in height and has a rather small flower. Its zone position is Hudsonian and Canadian.

Achillea lanulosa Nutt.

Common in the Transition zone at and below Wagon Camp. (Identified by C. L. Pollard.)

Achillea borealis Bong. Dwarf Alpine Yarrow.

Occurs in places on the stony pumice slopes above timberline. Between the heads of Mud and Squaw creeks Vernon Bailey found it at an altitude of 9,600 feet. (Identified by C. L. Pollard.)

Anaphalis margaritacea (L.) B. & H.

Common in dry open places in the chaparral from Sisson to Wagon Camp. (Identified by Professor Greene.)

Antennaria geyeri Gray. Geyer Everlasting.

A large specimen of this handsome everlasting was collected by Vernon Bailey in the Transition zone just below Wagon Camp September 25. The species was not noted elsewhere. (Identified by Miss Eastwood and Professor Greene.)

Antennaria media Greene [=*A. alpina* Auct.]. Alpine Everlasting.

Common in open parts of the Hudsonian zone in the neighborhood of timberline on most parts of Shasta and on Shastina. On ordinary slopes it ranges from an altitude below 8,000 feet up to about 9,000. (Identified by Professor Greene.)

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[1] Pittonia, IV, pp. 38–39, March 17, 1899.

Arnica merriami Greene.[1]

Common in the heather meadows and along the edges of streams in most parts of the Hudsonian zone. This new species has just been described by Professor Greene from specimens collected by us on the moist banks of the small west arm of Upper Squaw Creek, under the alpine hemlocks, where it is very common.

Arnica longifolia D. C. Eaton.

Common in moist places in the Canadian zone, chiefly on the banks of streams. (Identified by Professor Greene.)

Arnica viscosa Gray.

This singular species, which differs strikingly in appearance and habit from most members of its genus, grows in dense patches, usually 2 or 3 feet in diameter, among the bare lava rocks on steep slopes near timberline. On the south side of Shasta it was fairly common and flowering abundantly in August. (Identified by Miss Eastwood.)

Artemisia tridentata Nutt. True Sagebrush.

Sagebrush is unknown in the region about Shasta except in Shasta Valley, which it invades and overspreads from the Klamath country on the north. It reaches the extreme south end of Shasta Valley and penetrates a short distance into the bordering forest of ponderosa pines, where it mixes with *Kunzia tridentata.* Pushing southeasterly over Shasta Valley it reaches the gap at Sheep Rock. Its zone position is Upper Sonoran and Transition.

Artemisia ludoviciana Nutt.

A form of *Artemisia ludoviciana* is common in places just below Wagon Camp, along the upper edge of the Transition zone. When the species and subspecies now lumped under the above name are properly defined, several useful zone plants may be added to their appropriate lists.

Machæranthera shastensis Gray. Shasta Alpine Aster.
[=*Aster shastensis* Auct.].

A dwarf alpine species abounding on the bare rocky pumice slopes in the neighborhood of timberline, and common also on the borders of the heather beds in the glacial meadows. This is the type form. A related but unnamed form, usually a foot and a half or more in height, is common and widely distributed on the lower slopes, chiefly in the upper part of the Transition and lower part of the Canadian zones.

Oreastrum alpiginum (Gray) Greene.

Common in the neighborhood of timberline, particularly in moist places. (Identified by Professor Greene.)

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[1] Pittonia, IV, p. 36, March 17, 1899.

Chænactis nevadensis (Kellogg) Gray. Alpine Chænactis.

This curious composite, with whitish tubular flowers, much divided sticky leaves, and a smell like that of alcoholic specimens, occurs here and there in the pumice sand and among the broken lava shale above timberline. It was first seen in flower on the north side of Shastina July 24 (alt. 9,000 feet), and early in August was flowering plentifully on the south slope of Shasta above the head of Squaw Creek (alt. 9,300 feet). (Identified by Professor Greene.)

Chrysothamnus bloomeri (Gray) Greene.

One of the commonest and most widely distributed plants of the higher slopes, where it occupies pumice soils from the bottom of the Hudsonian zone up to several hundred feet above timberline. It was rarely found above an altitude of 9,000 feet.

This plant is very long lived, and although the part above ground is relatively small it springs from a large woody base resembling that of the true sagebrush. The root is enormous. The main taproot (sometimes double) usually sinks so deeply into the soil that I was unable to dig one up without breaking off the terminal point. In mature plants the main root measures about 200 millimeters in circumference where it enters the ground, and is 500 to 600 millimeters in length. It gives off numerous small and slender rootlets some of which exceed 600 millimeters in length. The height of the plant above ground rarely exceeds 150 millimeters.

Chrysothamnus bloomeri angustatus (Gray) Greene.

Common at Wagon Camp and in various parts of the Transition zone, usually scattered through the manzanita chaparral. Vernon Bailey collected it at Sheep Rock. (Identified by Professor Greene.)

Chrysothamnus occidentalis Greene. Rabbit Brush.

Fairly common in open spots on the lower slopes throughout the Transition zone, where it is mixed with *Kunzia tridentata*, *Arctostaphylos patula*, and *Ceanothus velutinus*. This large white-stemmed species occurs sparingly in dry soil at Sisson, and thence to Edgewood and Shasta Valley, in the upper edge of the Upper Sonoran zone, where it is common among the sagebrush. It was obtained at Sheep Rock by Vernon Bailey. (Identified by Professor Greene.)

Chrysothamnus viscidiflorus Nutt.

Common in the upper part of the Upper Sonoran zone in Shasta Valley. (Identified by Professor Greene.)

Erigeron armeriæfolium Turcz.

Rather common near timberline. Specimens were collected above Squaw Creek, near the head of Mud Creek Canyon, and on the north slope of Shastina. (Identified by Professor Greene.)

Erigeron compositus trifidus Hook.

Common on the slopes of broken shale and pumice above timberline, where it often grows in mats of *Silene suksdorfi* close under the edges of rocks. On the south side of Shasta it was not observed lower than 9,200 feet, but on the cold north slope of Shastina it was found as low as 8,900 feet. Its yellow flowers are rather conspicuous, and were noted from the latter part of July until late in August. (Identified by Professor Greene.)

Erigeron inornatus Gray.

This tall and much-branched *Erigeron* was found in Mud Creek Canyon and along Squaw Creek, a little below the fall, at an altitude of 6,800 feet. (Identified by Professor Greene.)

Eupatorium occidentale Hook.

Collected by Vernon Bailey and Miss Wilkins on Horse Camp Trail on the boundary between the Transition and Canadian zones. (Identified by Professor Greene.)

Heleniastrum rivulare Greene.

Common on damp ground at Wagon Camp, on the boundary between the Canadian and Transition zones. (Identified by Miss Eastwood.)

Hulsea nana Gray.

A common and characteristic plant of the barren alpine slopes above timberline, where its showy yellow heads are conspicuous among the bare rocks. Its leaves are sticky, crinkled, and relatively smooth. It was found on most of the high ridges above timberline all the way around the mountain, and was obtained on the north side of Shastina at an altitude of 9,000 feet. Its highest limit on the southwest side, as observed by Vernon Bailey, is 11,300 feet. (Identified by Miss Eastwood and Professor Greene.)

Hulsea larseni Gray.

Common on the pumice slopes above timberline, growing with *H. nana*, from which it may be easily distinguished by the leaves, which are covered with a dense whitish pubescence. (Identified by Professor Greene.)

Madia bolanderi Gray.

Very common in the marsh at Wagon Camp, where it was in blossom all summer. Common also along some of the streams in the upper part of the Transition zone, where the low temperature resulting from the water carries narrow tongues of Canadian zone species down to altitudes below their normal limits. (Identified by Miss Eastwood.)

Senecio trigonophyllus Greene.

Common along Panther Creek in the Shasta fir belt. (Identified by Miss Eastwood and Professor Greene.)

Senecio canus Hook.

Common on the rock-strewn pumice slopes above timberline. (Identified by Miss Eastwood and Professor Greene.)

Solidago elongata Nutt.

Abundant in open grassy places at Wagon Camp, where it was in flower in August and September. (Identified by Professor Greene.)

Agoseris monticola Greene.[1] Alpine Dandelion.

Abundant in the neighborhood of timberline on the stony slopes and basins, where its yellow dandelion-like flowers were conspicuous from the end of July until the middle of September. On warm southerly slopes it was observed as high as 9,750 feet. Its wavy leaves are sometimes entire, sometimes indented or cut. This species has just been described by Professor Greene from specimens collected by us at timberline on Shasta.

Crepis intermedia Gray.

Collected by Miss Wilkins in Mud Creek Canyon near the mouth of Clear Creek, where its zone position is either Hudsonian or Canadian. (Identified by F. V. Coville.)

Hieracium albiflorum Hook.

Common in places along the upper part of the Transition zone. Collected at Wagon Camp, on Squaw Creek, and on a warm slope in Mud Creek Canyon near the mouth of Clear Creek. (Identified by Miss Eastwood and Professor Greene.) A dwarf alpine form, apparently not yet named, occurs above timberline and is fairly common above the head of Squaw Creek, growing with *H. horridum.*

Hieracium cynoglossoides nudicaule Gray.

Very common in the Transition zone just below Wagon Camp. (Identified by Professor Greene.)

Hieracium horridum Fries.

Common in places on the higher slopes at and above timberline, forming small and densely hairy tufts among the rocks. The plant, particularly when young, is completely covered by a very dense growth of stiff silky white hairs which give it a woolly appearance.

Hieracium gracile Hook.

Common in the heather beds just below timberline, where its conspicuous yellow flowers were in blossom the early part of August. (Identified by Miss Eastwood and Professor Greene.)

Hieracium greenei Gray.

Fairly common just below Wagon Camp in the Transition zone. The type locality of this species is in the Scott Mountains a little west of Shasta. (Identified by Professor Greene.)

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[1] Pittonia, IV, p. 37, March 17, 1899.

Ptiloria lactucina (Gray) Greene. (=*Stephanomeria lactucina* Auct.)

This curious composite, with milky juice and conspicuous pinkish flowers, suddenly appeared on burns near Wagon Camp the latter part of August. It was not observed elsewhere. (Identified by Miss Eastwood and Professor Greene.)

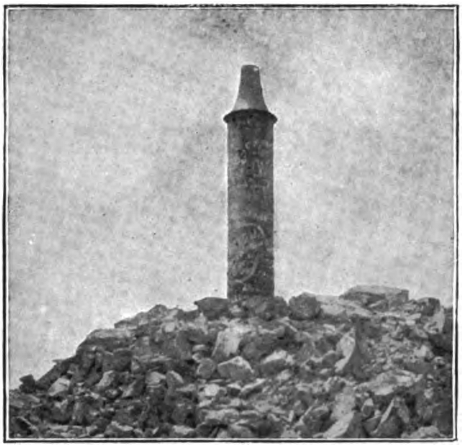

FIG. 46.—Monument on summit of Shasta. (Photographed by W. H. Osgood.)

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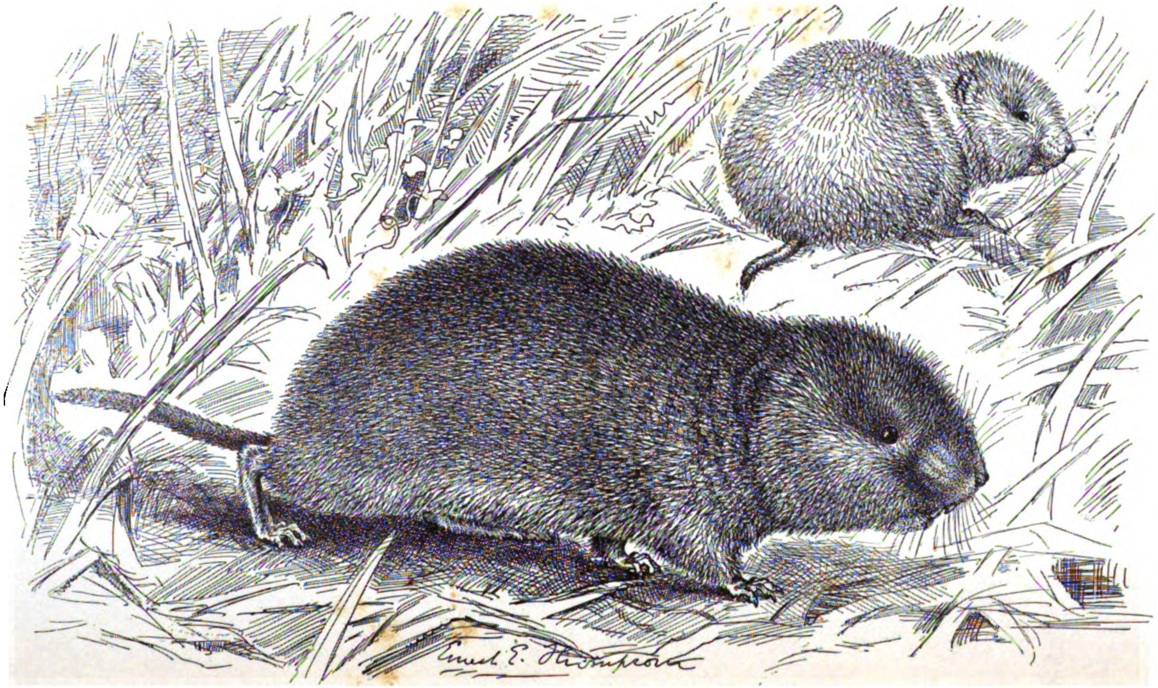

COMMON VOLE OR MEADOW MOUSE (*Microtus pennsylvanicus*).

U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 17

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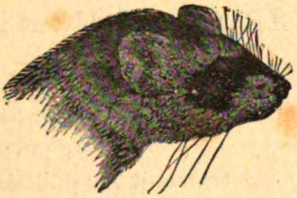

REVISION OF AMERICAN VOLES OF THE GENUS MICROTUS

BY

VERNON BAILEY
CHIEF FIELD-NATURALIST

Prepared under the direction of
Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

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U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., March 10, 1900.

SIR: I have the honor to transmit for publication, as No. 17 of North American Fauna, 'A Revision of the American Voles of the Genus *Microtus*,' by Vernon Bailey, Chief Field Naturalist of the Biological Survey.

Respectfully,
C. HART MERRIAM,
Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

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No. 17. NORTH AMERICAN FAUNA. June, 1900.

REVISION OF AMERICAN VOLES OF THE GENUS MICROTUS.

By VERNON BAILEY.

INTRODUCTION.

The following synopsis of American voles is based on a study of between 5,000 and 6,000 specimens from more than 800 localities, including types or topotypes of every recognized species with a known type locality, and also types or topotypes of most of the species placed in synonymy. Voles, or meadow mice, occur throughout the greater part of the northern hemisphere north of the Tropics. In North America both species and individuals reach their maximum abundance in the Canadian and Transition zones, and from this broad belt the number of species decreases on both sides. On the north a few species occur in the Hudsonian and Arctic zones, and individuals are abundant even in the barren grounds, or 'tundras,' north to the arctic coast. South of the Transition zone the decrease in species and individuals is rapid. In the Upper Austral zone they are scarce; in the Lower Austral rare and exceedingly local; while in the Tropical only a single species, of very limited distribution, is known. To the south, as individuals decrease in abundance and species become restricted to distinct areas, the degree of specific and superspecific differentiation becomes more and more marked. Of the nine American subgenera, one (*Neofiber*) is confined to Florida, and two (*Orthriomys* and *Herpetomys*) are restricted to two isolated mountains in southern Mexico. Another (*Pitymys*) is mainly Austral, and is confined to the southeastern United States and a small area in southeastern Mexico. Three others (*Pedomys*, *Lagurus*, and *Chilotus*) are found mainly in the Transition zone, and reach but little north of the United States. The subgenus *Arvicola* belongs to mountains in the Hudsonian and Canadian zones; and the polymorphous subgenus *Microtus* is the only one that enters the arctic regions.

Voles adapt themselves to the most diverse conditions of environment. Many of the species inhabit moist or wet ground and several are mainly aquatic; others inhabit areas of excessive humidity, while a few live in dry and even arid regions. Some live in the perpetual shade of dense forests, others are exposed to the full effects of light on the open plains. Some of the most striking peculiarities of the different species result from these different conditions of environment. The development of oil and musk glands is most pronounced in the aquatic species of the subgenera *Neofiber* and *Arvicola* and least in the subgenera *Lagurus* and *Pedomys* of the dry regions. The color is palest in species most exposed to light and dryness, as in *curtatus* and *pallidus*, and darkest and richest in species from shaded and humid areas, as in *quasiater* and *umbrosus*.

The ranges of most of the species and subspecies conform to the limits of well-defined life zones, except in the subaquatic species, which follow water courses and often have the appearance of being out of their proper zones.

HABITS.

Certain peculiarities of habits are common to nearly all of the species. None are known to hibernate, but in the North they have snug winter homes under the snow, where they move about freely in numberless tunnels. They burrow in the ground, and are famous for their little roads or smooth trails which run through the grass from burrow to burrow or away to their feeding grounds. Bulky nests of grass and soft plant fibers are placed in underground cavities, or on the surface of the ground under cover of snow, logs, or dense vegetation. The nest is depressed globular in form, with an open chamber in the center, which contains a soft bed, and has one or two round entrances at the sides. These nests are the sleeping places of the old and the nurseries of the young. They are kept surprisingly clean and fresh, and new ones are frequently made to take the place of those that are old or imperfect.

Breeding.—Voles seem to have no definite breeding season. Four to eight young are usually produced at a birth, and as far north as Minnesota I have found them in the nests at all seasons of the year. Their increase is accordingly very rapid, and is only partially counterbalanced by the host of enemies that prey upon them. They form the principal food of nearly all owls and some hawks, while weasels, minks, foxes, coyotes, cats, badgers, skunks, and many other animals, as well as certain snakes, feed extensively on them. But in spite of their enemies they seem to hold their own, and tend to increase faster as the country becomes more thickly settled and the larger mammals and birds are destroyed.

Food.—Meadow mice choose a somewhat varied diet, but their food consists mainly of green vegetation, roots, and bark. Grass, especially the tender base of grass stems, forms the bulk of their food, but almost every plant with which they come in contact is eaten to some extent. Bark, both from roots and trunks of trees and shrubs, is a favorite winter food. Seeds and grain are eaten when found, but are not especially sought; flesh in any form is never refused. As the animals are active all winter and food is always abundant, they do not ordinarily lay up stores, although Mr. E. W. Nelson found *M. operarius*, of Alaska, storing roots.[1]

ECONOMIC STATUS.

Injury to trees and crops.—Though small enough to be commonly called mice (meadow mice, upland mice, field mice, pine mice, ground mice, bear mice, etc.), they make up in numbers what they lack in size, and over the whole breadth of the continent lay a heavy tribute on many products of the farm. Too small and too numerous to be successfully destroyed by traps, guns, or poison, they prove one of the most difficult enemies with which the farmer has to contend. If they would confine themselves to meadows, their mischief would be limited to the destruction of a comparatively small amount of grass; but they prefer growing grain to grass, and by running long tunnels under ground, or making little paths under cover of the vegetation, gain easy and safe access to the fields. With a stroke of their chisel-like teeth they fell the stalks of wheat and oats and eat the tender parts, together with some of the grain. It is so easy to cut down the stalks that they destroy many times as much as they need for food. The work of a few animals is insignificant, but the work of millions makes heavy inroads on growing crops. Later in the season, when the grain is cut and left standing in shocks or stacks, the field mice take possession, building their nests and establishing their homes under its cover. In shocks of corn and wheat left for a long time the grain is often completely devoured, and that remaining all winter in stacks suffers in proportion to the number of the little animals that make their homes in it. Even stacks of hay are often found in spring with the lower parts cut to chaff and filled with the nests of meadow mice.

When the snow comes these little rodents can safely leave their cover of weeds, grass, or bushes and plow their way under the snow on long exploring expeditions. The tunnels thus formed remain as open passages until the snow melts in spring, giving the animals free and safe conduct from the meadows to the uplands, into fields, orchards, gardens, and nurseries. There is no sign from above of what is happening below the surface; but later on, in spring, when the snow disappears, trees and shrubs are found stripped of their bark for a wide space near the ground. The marks of tiny teeth remain in the hard wood, and little piles of dry outer bark, mixed with characteristic pellets of excreta, show what animal has been at work. The uncovered roads may be seen leading from tree to tree, to winter nests on the surface of the ground, and back to the cover of brush or meadows. Shrubs and small trees are often stripped of their bark and killed, and sometimes even well-grown apple trees, 10 inches or a foot in diameter, are completely girdled. Usually, however, large trees are gnawed on only one side. In this case, although they are not killed at once, the wood thus exposed usually decays in a few years, the trees become hollow at the base, their productiveness is impaired, and they die prematurely.

---

[1] Proc. Biol. Soc. Wash., VIII, 140, 1893.

Protection of trees from voles.—Various means have been resorted to for protecting fruit trees and shrubs from these ravages, but with only partial success. Wire netting and tin cylinders placed around the bases of the trees in autumn are generally considered the surest protection, but in most cases this is too expensive to be practicable. Wrapping the trunks with burlap or twisted ropes of straw, or coating them with whitewash, tar, or other unpalatable substances, are common methods of protection used with varying degrees of success. But as some species of voles eat the bark from the roots below the surface of the ground, none of these resources insure perfect protection.

Destruction of voles.—The importance of placing every possible check on the increase of these animals and of reducing their numbers when they become too numerous is obvious. No direct method of accomplishing these ends has as yet been devised, but the desired result can be attained indirectly by avoiding or preventing the useless destruction of their natural enemies. Owls and some species of hawks live almost exclusively upon them, watching for them night and day in the grass, and are always ready to pounce on any that appear above the snow. Weasels run through their burrows and trails, and not only kill enough for food, but destroy great numbers for the mere pleasure of killing. In spite of these well-known and often reiterated facts, bounties are still paid for the destruction of hawks and owls in counties where the annual loss in fruit trees and grain from the ravages of field mice if computed would amount to a startling sum. In the spring ot 1895 I examined a small apple orchard in Washtenaw County, Mich., in which several choice trees had been killed and many others injured during the preceding winter by the common vole (*Microtus pennsylvanicus*). The owner of the orchard considered $50 a low estimate of the damage done. At the same time the county of Washtenaw was taxing the farmers to pay a bounty of 25 cents each on all hawks and owls, while the several gun clubs of the county gave these birds a high count in their competitive hunting matches. Many similar instances could be cited. Who was ever known to miss an opportunity to destroy a hawk or weasel? The diminution of foxes, minks, coyotes, and such predatory mammals may be necessary, but if so, the protection and encouragement of other less harmful species becomes doubly important, and in fact imperative, if we are to escape such devastating hordes of voles as have occasionally swept over certain parts of Europe, particularly in Scotland,[1] Germany,[2] Italy,[2] Russia,[2] and Thessaly.[1]

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[1] Parliamentary Report of Plague of Field Voles in Scotland, London, 1893.
[2] U. S. Consular Reports, L, No. 187, 539–543, 1896.

DETERMINATION OF SPECIES.

It is not many years since certain prominent writers treated as mere varieties, or subspecies, animals that belong to widely different subgenera, while others described and named with full specific rank every different condition of pelage in a single species. In some cases the original type was not preserved, or no type was designated by the describer, or still worse, the type locality was not given, so that subsequent writers renamed these same species or confounded them with others. The resulting confusion can now be cleared up by means of series of specimens collected within the past ten years at most of the known type localities, and in the general region of those not definitely known. The series of specimens available, and the number of localities represented, make it possible to define almost every North American species from typical specimens, and in most cases to give the various changes of pelage due to season and age. When possible, the original types have been compared with the new series of specimens from the type localities, and in this way the names *californicus*, *trowbridgi*, *edax*, *occidentalis*, *townsendi*, *longirostris*, and *modestus* have been sifted out with the following result: *californicus* stands for a widely distributed western species with *trowbridgi* as a synonym; *edax* as a well-marked species, but one in which the name has been persistently misapplied; *occidentalis* as a synonym of *townsendi; longirostris* as a synonym ot *montanus;* and *modestus* as a western form of *pennsylvanicus*. The type of *montanus* is lost, but a series of 57 specimens from the type locality agrees with Peale's description of the species. The types of *modestus* and *edax* are immature specimens made up with the skulls inside the skins. It was only by the removal of the skulls that even the group to which the species belonged could be determined.[1]

MATERIAL EXAMINED.

The following synopsis of the genus *Microtus* is based mainly on a study of specimens in the collection of the Biological Survey and that of Dr. C. Hart Merriam, both of which are in the United States National Museum. For the use of much additional material, including types and topotypes, my thanks are heartily extended to Dr. F. W. True, executive curator, and Mr. Gerrit S. Miller, jr., assistant curator of mammals, United States National Museum; to Dr. J. A. Allen, curator of mammals and birds, and Mr. Frank M. Chapman, assistant curator, American Museum of Natural History; to Mr. D. G. Elliot, curator of the Department of Zoology, Field Columbian Museum; and to Mr. Outram Bangs. Most of all, I am indebted to Dr. C. Hart Merriam, who, after doing much work on the genus, has placed his manuscript, drawings, and large private collection of specimens at my disposal, besides giving me constant criticism and advice. Among others who have contributed material or notes my thanks are especially due to Mr. E. W. Nelson, who has collected all the known Mexican species of *Microtus* and has contributed the notes on their zonal distribution.

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[1] Through the kindness of Dr. True and Mr. Miller, skulls have also been removed from a large number of specimens from Alaska and Arctic America, so that it has been possible for the first time to identify the species and make use of the localities in determining their ranges.

Seventy species and subspecies are here recognized. Of these 54 actual types and series of topotypes of 13 additional forms have been examined, while of the three remaining forms, for which no type exists or is accessible and no definite type locality is known, specimens have been examined from the type region, or as near to it as can be determined. Three forms, *Microtus californicus constrictus*, *M. ludovicianus* and *M. scirpensis* are described as new. Except for a relatively small number of alcoholics and a few skeletons, the specimens are mostly well-prepared skins with cleaned skulls and are accompanied by collectors' measurements.

All measurements are in millimeters, and external measurements, unless otherwise stated, are taken in the flesh by collectors. Skull measurements are my own, made from perfect skulls unless otherwise stated. The skull drawings are by Dr. James C. McConnell. Most of the drawings of teeth have been used in previous publications of the Biological Survey.

Subfamily MICROTINÆ Cope.[1]

The subfamily *Microtinæ* includes the Voles of the genera *Microtus*, *Evotomys*, and *Phenacomys;* the Lemmings of the genera *Lemmus*, *Discrostonyx*, and *Synaptomys;* and the Muskrats of the genus *Fiber*. As the genera and subgenera of the family have been recently treated in detail by Mr. Gerrit S. Miller, jr.,[2] it is only necessary to give briefly the characters distinguishing the genus *Microtus*.

Genus MICROTUS Schrank.

Generic characters.—Lower incisors with roots extending far behind and on outer side of molar series; upper incisors not grooved; molars rootless, with outer and inner reentrant angles approximately equal. Palate with median ridge, distinct lateral pits, complete lateral bridges[3] (not terminating in posterior shelf in any American species). Tail as long as or longer than hind foot, terete; claw of thumb pointed, not strap-shaped.

SUBGENERA.

Nine subgenera are here recognized among the living species of North America.[4] Five of these (*Chilotus*, *Pedomys*, *Herpetomys*, *Orthriomys*, and *Neofiber*) are found only in North America. The remaining four (*Microtus*, *Pitymys*, *Arvicola*, and *Lagurus*) include also Old World species. All of the nine subgenera, save *Microtus*, are sharply defined and easily distinguished by either cranial or external characters. The subgenus *Microtus* contains many more species than all of the other subgenera together, and species differing so widely that only the most general characterization can be applied to it. It is a composite group containing all forms that do not fit into the other more restricted subgenera and yet are not sufficiently differentiated to merit subgeneric rank.

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[1] *Microtidæ* Cope, Syllabus Lectures Geol. and Paleont., p. 90, 1891. *Microtinæ* Rhoads, Am. Nat., XXIX, 940, Oct., 1895.

[2] North American Fauna No. 12, Genera and Subgenera of Voles and Lemmings, 1896.

[3] Usually incomplete in *Neofiber*.

[4] The extinct species of *Microtus* are not included in the present paper.

KEY TO SUBGENERA OF MICROTUS.

$\overline{\mathrm{m3}}$ with 3 transverse loops and no closed triangles. Plantar tubercles 5 or 6.
$\underline{\mathrm{m3}}$ with 3 closed triangles,[1] mammæ 8.[2]
Plantar tubercles 6, side glands on hips in adult males (on flanks in *xanthognathus*) .... *Microtus*
Plantar tubercles 5, side glands on flanks or else inconspicuous.
Side glands conspicuous on flanks of adult males, size large .... *Arvicola*
Side glands obscure or wanting, size small .... *Chilotus*
$\underline{\mathrm{m3}}$ with 2 closed triangles, mammæ 4 or 6.
Skull wide and flat, tail very short, fur short and dense, mammæ 4 .. *Pitymys*
Skull high and narrow, tail medium, fur coarse, mammæ 6 .... *Pedomys*

$\overline{\mathrm{m3}}$ with 2 transverse loops and 2 median triangles, plantar tubercles 5.
$\overline{\mathrm{m1}}$ with 5 closed triangles.
Side glands conspicuous in both sexes, mammæ 6, size very large, tail long .... *Neofiber*
Side glands obscure, mammæ 8, size small, tail very short .... *Lagurus*
$\overline{\mathrm{m1}}$ with 3 closed triangles.
$\underline{\mathrm{m3}}$ with 3 closed triangles, mammæ 6, tail short .... *Herpetomys*
$\underline{\mathrm{m3}}$ with 2 closed triangles, mammæ 4, tail long .... *Orthriomys*

LIST OF SPECIES AND SUBSPECIES, WITH TYPE LOCALITIES.

Microtus abbreviatus Miller. Hall Island, Bering Sea, Alaska.
acadicus Bangs. Digby, Nova Scotia.
alleni (True). Georgiana, Brevard County, Florida.
alticolus (Merriam). Little Spring, San Francisco Mountain, Arizona, 8,200 feet.
angusticeps Bailey. Crescent City, California.
arizonensis Bailey. Springerville, Arizona.
arvicoloides (Rhoads). Lake Keechelus, Washington, 8,000 feet.
auricularis Bailey. Washington, Mississippi.
austerus (Le Conte). Racine, Wisconsin.
aztecus (Allen). Aztec, Rio Arriba County, New Mexico, 5,900 feet.
bairdi Merriam. Crater Lake (Glacier Peak), Oregon, 7,800 feet.
breweri (Baird). Muskeget Island, Massachusetts.
californicus (Peale). San Francisco Bay, California.
canescens Bailey. Conconully, Washington.
canicaudus Miller. McCoy, Oregon.
chrotorrhinus (Miller). Mount Washington, head of Tuckerman Ravine, New Hampshire, 5,300 feet.

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[1] Except *Microtus breweri*, in which 2 are usually confluent, and *chrotorrhinus*, which has 5 closed triangles.

[2] Except in the *Microtus mexicanus* group, in which the number is 4.

Microtus constrictus Bailey. Cape Mendocino, California.
curtatus (Cope). Pigeon Spring, Mount Magruder, Nevada.
drummondi (Aud. & Bach.). Rocky Mountains, vicinity of Jasper House, Alberta, Canada.
dutcheri Bailey. Big Cottonwood Meadows, near Mount Whitney, California, 10,000 feet.
edax (Le Conte). California (south of San Francisco).
enixus Bangs. Hamilton Inlet, Labrador.
fisheri Merriam. St. Matthew Island, Bering Sea, Alaska.
fontigenus Bangs. Lake Edward, Quebec.
fulviventer Merriam. Cerro San Felipe, Oaxaca, Mexico.
guatemalensis Merriam. Todos Santos, Huehuechenango, Guatemala, 10,000 feet.
haydeni (Baird). Fort Pierre, South Dakota.
innuitus Merriam. St. Lawrence Island, Bering Sea, Alaska.
kadiacensis Merriam. Kadiak Island, Alaska.
labradorius Bailey. Fort Chimo, Ungava, Labrador.
leucophæus (Allen). Graham Mountains, Arizona.
longicaudus (Merriam). Custer, South Dakota.
ludovicianus Bailey. Iowa, Calcasieu Parish. Louisiana.
macfarlani Merriam. Fort Anderson (north of Great Bear Lake), Arctic America.
macropus (Merriam). Pahsimeroi Mountains, Idaho, 9,700 feet.
macrurus Merriam. Lake Cushman, Olympic Mountains, Washington.
mexicanus (De Saussure). Mount Orizaba, Mexico.
minor (Merriam). Bottineau, North Dakota.
modestus (Baird). Sawatch Pass (Cochetopa Pass). Colorado.
mogollonensis (Mearns). Baker Butte, Mogollon Mountains, Arizona.
montanus (Peale). Headwaters of Sacramento River, near Mount Shasta, California.
mordax (Merriam). Sawtooth (or Alturas) Lake, Idaho, 7,200 feet.
nanus (Merriam). Pahsimeroi Mountains, Idaho.
nemoralis Bailey. Stillwell (Boston Mountains), Indian Territory.
nesophilus Bailey. Great Gull Island, New York.
nevadensis Bailey. Ash Meadows, Nye County, Nevada.
nigrans Rhoads. Currituck, North Carolina.
operarius (Nelson). St. Michael, Alaska.
oregoni (Bachman). Astoria, Oregon.
pallidus (Merriam). Fort Buford, North Dakota.
pauperrimus (Cooper). Plains of Columbia, near Snake River, Washington.
pennsylvanicus (Ord). Pennsylvania (near Philadelphia).
phæus Merriam. North slope Sierra Nevada de Colima, Jalisco, Mexico, 10,000 feet.
pinetorum (Le Conte). Pine forests of Georgia (probably near the old Le Conte plantation at Riceboro, Georgia.)
popofensis Merriam. Popof Island, Shumagin Islands, Alaska.
quasiater (Coues). Jalapa, Vera Cruz, Mexico.
rivularis Bailey. St. George, Utah.
richardsoni (De Kay). Near foot of Rocky Mountains, vicinity of Jasper House, Alberta, Canada.
scalopsoides (Aud. & Bach.). Long Island, New York.
scirpensis Bailey. Amargosa River, California, near California-Nevada line.
serpens Merriam. Agassiz, British Columbia.
sitkensis Merriam. Sitka, Alaska.

Microtus terrænovæ (Bangs). Codroy, Newfoundland.
tetramerus (Rhoads). Beacon Hill Park, Victoria, British Columbia.
townsendi (Bachman). On or near Wappatoo (Sauvie) Island, Willamette River, Oregon.
umbrosus Merriam. Mount Zempoaltepec, Oaxaca, Mexico, 8,200 feet.
unalascensis Merriam. Unalaska Island, Alaska.
vallicola Bailey. Lone Pine, Inyo County, California.
yakutatensis Merriam. Yakutat Bay, Alaska.
xanthognathus (Leach). Hudson Bay.

Subgenus MICROTUS Schrank.

Type.—*Microtus terrestris* Schrank (=*Mus arvalis* Pallas).
Microtus Schrank, Fauna Boica, I, 1ste Abth., 72, 1798.
Microtus Miller, N. Am. Fauna No. 12, 63, July 23, 1896 (subgenus).

Geographic distribution (in North America).—From the Arctic Ocean southward to southern Mexico, and across the continent, mainly in Boreal, Transition, and Upper Austral zones.

Subgeneric characters.—Plantar tubercles 6; lateral glands on hips in adult males;[1] mammæ normally 8, 4 inguinal and 4 pectoral;[2] ears usually overtopping fur; m1 normally with 5 closed triangles;[3] m3 with 3 transverse loops and no triangles; m2 with 4 closed sections, and in most eastern species an additional posterior inner loop; m3 with 3 closed triangles (except in *chrotorrhinus* and *abbreviatus* groups).

GROUPS IN THE SUBGENUS MICROTUS.

The subgenus *Microtus* is readily divided into 10 fairly well-marked groups of slightly superspecific rank that may be conveniently designated by the name of their best-known or most characteristic species. These groups are not of great importance or of equal rank, but for showing the relationship of species and for convenience in arrangement they serve a useful purpose.

1. **Pennsylvanicus Group**, characterized by a posterior fifth loop to middle upper molar, includes *pennsylvanicus, nigrans, acadicus, modestus, fontigenus, labradorius, enixus, aztecus, drummondi, terrænovæ, nesophilus*, and *breweri*.
2. **Montanus Group**, characterized by moderately short tail and constricted incisive foramina, includes *montanus, arizonensis, nanus, canescens, canicaudus, nevadensis, rivularis*, and *dutcheri*.
3. **Townsendi Group**, characterized by large size, long tail, and dark-brown color, includes *townsendi* and *tetramerus*.
4. **Californicus Group**, characterized by large size and wide-open incisive foramina, includes *californicus, constrictus, vallicola, edax*, and *scirpensis*.
5. **Longicaudus Group**, characterized by long tail and gray color, includes *longicaudus, mordax, macrurus, angusticeps, alticolus*, and *leucophæus*.
6. **Mexicanus Group**, characterized by short tail, brown color, and only 4 mammæ, includes *mexicanus, phæus, fulviventer*, and *mogollonensis*.

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[1] In front of hips in *xanthognathus* and probably in *chrotorrhinus*.

[2] Four in the *mexicanus* group, a pair of inguinal and a pair of pectoral.

[3] With only four closed triangles in most of the Alaska species.

7. **Operarius Group**, characterized by short tail and only 4 closed triangles in anterior lower molar, includes *operarius, macfarlani, kadiacensis, unalascensis, sitkensis, yakutatensis, popofensis,* and *innuitus.*
8. **Abbreviatus Group**, characterized by robust form, very short tail, 5 closed triangles in anterior lower molar, and two closed and one open in posterior upper, includes *abbreviatus* and *fisheri.*
9. **Chrotorrhinus Group**, characterized by yellow nose and five closed triangles in posterior upper molar, includes *chrotorrhinus* and *ravus.*
10. **Xanthognathus Group**, characterized by yellow nose, large size, glands on flanks, and 3 closed triangles in posterior upper molar, includes one species, *xanthognathus.*

In using the following key it will be necessary to have both skins and skulls in hand, and even then it will be impossible to identify some of the forms without actual comparison with their nearest allies. Whenever possible, several specimens should be examined, to avoid the danger of being led astray by abnormal molar patterns, for even the widest ranges of subgeneric differences are sometimes covered by individual variation or abnormal tooth pattern.

KEY TO SPECIES AND SUBSPECIES OF THE SUBGENUS MICROTUS.

- m2 with 4 closed angular sections and a rounded posterior loop.
  - m3 with two of the 3 triangles usually confluent.
    - Interparietal about as wide as long, colors pale.......................... *breweri*
    - Interparietal much wider than long, colors dark .... *nesophilus*
  - m3 with 3 closed triangles.
    - m1 with usually a sharp point or spur at base of posterior triangle; belly white with a median dusky line.. *terrænovæ*
    - m1 with normal truncate posterior triangle; belly without median dusky line.
      - Interparietal more than half as long as wide, belly white.
        - Skull long and narrow, braincase long, feet and tail stout............ *aztecus*
      - Interparietal about half as long as wide, belly usually dull colored.
        - Skull wide, braincase short, molars small.......................... *enixus*
        - Skull not wide, braincase medium, molars medium.
          - Colors dusky or blackish.
            - Size large, hind foot 23.. *nigrans*
            - Size small, hind foot 21.. *fontigenus*
          - Colors brownish or dark grayish.
            - Size medium.
              - Belly white or whitish.. *acadicus*
              - Belly dull.
                - Colors bright or dark brownish...................... *pennsylvanicus*
                - Colors paler, size less .... *modestus*
            - Size small, feet and tail very slender.
              - Skull low, incisors projecting, bullæ not large.............. *labradorius*
              - Skull high, incisors decurved, bullæ large................ *drummondi*
- m2 with 4 closed sections and no posterior loop (except irregularly in Californicus group.
  - Mammæ 4, inguinal, 1–1; pectoral, 1–1. Skull short and wide. Incisive foramina not constricted.
    - Colors bright rich brown above and below.......................... *fulviventer*
    - Colors dull brownish above and below.
      - Belly but little lighter than back.
        - Size medium.. *mexicanus*
        - Size slightly larger.. *phæus*
      - Belly much lighter than back; size small .... *mogollonensis*

- Mammæ 8, inguinal, 2–2; pectoral, 2–2.
  - $\overline{m1}$ with normally 4 closed triangles (sometimes 5 in *sitkensis*) and rounded anterior loop.
    - Bullæ very small and narrow, molars very light.
      - Skull narrow and slender .... *operarius*
      - Skull wider and heavier .... *kadiacensis*
    - Bullæ medium, molars moderately heavy.
      - Incisors strongly projecting.
        - Size large, hind foot 23 .... *innuitus*
        - Size small, hind foot 19 .... *macfarlani*
      - Incisors not strongly projecting, size medium.
        - Frontals heavily ridged in adult males.
          - Prezygomatic notch deep, color dusky gray or ochraceous.
            - Color dark ochraceous, belly dusky .... *sitkensis*
            - Color dusky gray, belly buffy gray .... *yakutatensis*
          - Prezygomatic notch shallow, color ochraceous .... *unalascensis*
        - Frontals not ridged in adults, color ochraceous .... *popofensis*
  - $\overline{m1}$ with 5 or 6 closed triangles.
    - A pair of glands on flanks of males, nose yellowish.
      - Size large, side glands conspicuous in adult males, $\underline{m3}$ with 3 closed triangles .... *xanthognathus*
      - Size smaller, glands obscure or wanting, $\underline{m3}$ with 5 closed triangles.
        - Color bister .... *chrotorrhinus*
        - Color grayish .... *ravus*
    - A pair of glands on hips of males, nose not yellow.
      - Incisive foramina not constricted posteriorly, $\underline{m2}$ with or without posterior loop.
        - Size large, colors dark, young blackish.
          - Nasals emarginate posteriorly .... *edax*
          - Nasals truncate posteriorly .... *scirpensis*
        - Size smaller, colors grayish, young dusky .... *californicus*
          - Colors clearer gray, bullæ smaller.
            - Skull wide .... *vallicola*
            - Skull narrow .... *constrictus*
      - Incisive foramina constricted posteriorly, $\underline{m2}$ normally without posterior loop.
        - Tail very short, size medium.
          - Belly dusky, lips and tip of nose white .... *dutcheri*
          - Belly, lips, and nose buffy.
            - Rostrum and nasals slender .... *abbreviatus*
            - Rostrum and nasals heavy .... *fisheri*
        - Tail medium, size large or small.
          - $\overline{m1}$ with 6 closed triangles and deep-lobed trefoil.
            - Size large, hind foot 24 .... *nevadensis*
          - $\overline{m1}$ with 5 closed triangles and anterior trefoil.
            - Size large, hind foot 23 .... *rivularis*
            - Size medium or small, hind foot 18–22, belly gray or whitish, ears large.
              - Hind foot 20 or more.
                - Color dark gray above .... *montanus*
                - Color rusty gray above .... *arizonensis*
              - Hind foot 20 or less.
                - Lateral pits of palate deep, tail bicolor.
                  - Color grizzled gray .... *nanus*
                  - Color ashy gray .... *canescens*
                - Lateral pits of palate shallow, tail mostly gray .... *canicaudus*

KEY TO SPECIES AND SUBSPECIES OF THE SUBGENUS MICROTUS—Cont'd.

- Tail long, about ⅓ of total length.
  - Hip glands conspicuous in males, colors dark brown.
    - Hind foot averaging 25.4 .... *townsendi*
    - Hind foot averaging 22 .... *tetramerus*
  - Hip glands not conspicuous, colors grayish, belly whitish.
    - Size large, hind foot 24 .... *macrurus*
    - Size medium, hind foot 22.
      - Anterior arm of frontal acuminate.
        - Skull narrow, bullæ small .... *angusticeps*
        - Skull normal, bullæ large.
          - Sides much grayer than back .... *mordax*
          - Sides scarcely grayer than back .... *longicaudus*
      - Anterior arm of frontal obliquely truncate.
        - Size small, foot 20 .... *alticolus*
        - Size larger, foot 22 .... *leucophæus*

MICROTUS PENNSYLVANICUS (Ord). Meadow Vole.

Mus pennsylvanica Ord, Guthrie's Geography, 2d American edition, II, 292, 1815. (Rhoads' reprint.) Based on Wilson's description of the meadow mouse from meadows below Philadelphia and along the seashore.

Mynomes pratensis Rafinesque, Am. Monthly Mag., II, 45, 1817. Based on Wilson's description of meadow mouse.

Lemmus noveboracensis Rafinesque, Annals of Nature, 3, 1820. (New York and New Jersey.)

Arvicola riparius Ord, Journ. Acad. Nat. Sci. Philadelphia, IV, Pt. II, 305–306, 1825. (Type locality not given.)

Arvicola palustris Harlan, Fauna Americana, 136–138, 1825. (Swamp along the shores of the Delaware.)

Arvicola hirsutus Emmons, Rept. Quad. Mass., 60, 1840.

Arvicola alborufescens Emmons, Rept. Quad. Mass., 60–61, 1840. (Williamstown, Mass.)

Arvicola fulva Aud. and Bach., Proc. Acad. Nat. Sci. Phila., I, 96, 1841. ("One of the Western States; we believe Illinois.")

Arvicola nasuta Aud. and Bach., Proc. Acad. Nat. Sci. Phila., I, 96–97, 1841. (Near Boston, Mass.)

Arvicola rufescens DeKay, Zool. N. Y., Mammals, I, 85, 1842. (Oneida Lake, N. Y.)

Arvicola oneida DeKay, Zool. N. Y., Mammals, I, 88–89, 1842. (Oneida Lake, N. Y.)

Arvicola dekayi Aud. and Bach., Quad. N. Am., III, 287–288, 1854. (New York or Illinois.)

Arvicola riparia var. *longipilis* Baird, Mammals N. Am., 524, 1857. (West Northfield, Ill., and Racine, Wis.)

Arvicola rufidorsum Baird, Mammals N. Am., 526, 1857.[1] (Holmes Hole, Marthas Vineyard, Mass.)

Type locality.—Pennsylvania (meadows below Philadelphia).

Geographic distribution.—Eastern United States and westward as far as Dakota and Nebraska, shading into *modestus* of the western plains and Rocky Mountains. In a general way it occupies the Transition zone from the Atlantic coast to the edge of the Great Plains.

Habitat.—Meadows, fields, and especially grassy places near water.

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[1] Not having seen the type of *rufidorsum* or any specimen from Marthas Vineyard, I hesitate to place this name in synonomy.

General characters.—Size medium; tail at least twice as long as hind foot; fur long, overlaid with coarse hairs; ears moderate, conspicuous above fur in summer, almost concealed in winter pelage; colors dusky gray or brownish; skull long, well arched, and rather smooth; middle upper molar with four triangles and a posterior loop.

Color.—*Summer pelage:* Upperparts dull chestnut brown, varying to bright yellowish chestnut, darkened along the back with coarse black hairs; belly dusky gray or tinged with cinnamon; feet brownish; tail dusky above, slightly paler below. *Winter pelage:* Duller and grayer throughout; tail indistinctly bicolor. *Young:* Blackish.

Cranial characters.—Skull long, usually not angular or much ridged; incisors projecting well in front of nasals; incisive foramina long, occupying two-thirds of the space between molars and incisors; bullæ moderately large and well rounded; molar series long; m2 with 4 closed triangles and a posterior loop; m3 with an anterior crescent, 3 closed triangles, and a posterior loop with two inner lobes; m1 with 5 closed triangles, anterior trefoil, 4 outer and 5 inner salient angles; m3 with 3 long inner and 3 short outer salient angles.

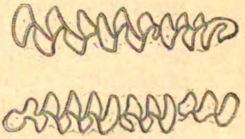

FIG. 1.—Molar enamel pattern of *Microtus pennsylvanicus* (× 5).

Measurements.—Average of 5 adults from Washington, D. C.: Total length, 171; tail vertebræ, 46; hind foot, 21.2. *Skull* (No. 30321, ♀ ad., from Washington, D. C.): Basal length, 27.4; nasals, 8.3; zygomatic breadth, 17.2; mastoid breadth, 12.7; alveolar length of upper molar series, 7.2.

Remarks.—The above description is based on a good series of specimens from the District of Columbia, showing the seasonal changes of pelage and agreeing perfectly with the Pennsylvania animal. From Pennsylvania south along the Atlantic coast, specimens show a noticeable increase in size and intensity of coloration, which reaches its maximum in the subspecies *nigrans* of North Carolina; while to the north they show a corresponding decrease in size and intensity of coloration, which reaches its extreme in the subspecies *acadicus* of Nova Scotia. To the westward *pennsylvanicus* is fairly typical as far as southern Michigan and Iowa, but on the plains of Nebraska and South Dakota it grows paler as it grades into *modestus*. Northward in Minnesota it becomes smaller until scarcely distinguishable from and perhaps grading into *drummondi* of northwest Canada. Three skulls in the U. S. National Museum, that seem to be typical *pennsylvanicus*, are labeled as coming from Prairie Mer Rouge, La., but I am inclined to question the authenticity of the labeling.

Specimens examined.—Total number, 716, from the following localities:

Pennsylvania: Philadelphia, 1; Chester County, 1; Carlisle, 6; Columbia, 2; Drurys Run (near Renovo), 6; Foxbury, 2; Pine Glen, 1; Leasuresville, 2; Bear Lake (Warren County), 2.

New York: Owego, 2; Nichols, 24; Lake George, 20; Alder Creek, 2; Locust Grove, 55; Peterboro, 9; Troy, 5; Geneva, 5; Brandon, 4; Catskill Mountains, 3; Highland Falls, 12; Mott Haven, 1; Oyster Bay, 2; Lake Grove, 2; Montauk Point, 45; Shelter Island, 6; Plum Island, 14; Roslyn, 4.

Connecticut: East Hartford, 2.

Massachusetts: Wilmington, 13; Middleboro, 19; Newtonville, 4; Holmes Hole, 1; Woods Holl, 1.

Vermont: Burlington, 4.

New Hampshire: Ossipee, 15.

Maine: Addison, 1; Calais, 1.

New Jersey: Tuckerton, 4; Mays Landing, 1; Sea Island City, 1.

Maryland: Laurel, 23; Hyattsville, 7; Bladensburg, 1; Mountain Lake Park, 2; Finzel, 1; Grantsville, 1.

District of Columbia: Washington, 64.

Virginia: Falls Church, 2; Dunn Loring, 2; Arlington, 2; Fort Myer, 1; Bristoe, 1.

West Virginia: Travellers Repose, 2; White Sulphur Springs, 3.

North Carolina: Roan Mountain, 45; Old Richmond, 3; Raleigh, 20.

Ohio: Garrettsville, 10; Salem, 1.

Michigan: Detroit River, 1; Manchester, 3; Ann Arbor, 2.

Illinois: West Northfield, 6.

Wisconsin: Racine, 14; Busseyville, 1; Milwaukee, 4; Saxeville, 1; Fisher Lake (Iron County), 14.

Iowa: Knoxville, 2.

Missouri: St. Louis, 5.

Louisiana: Prairie Mer Rouge, 3.

Nebraska: Blair, 3; Valentine, 2.

Minnesota: Elk River, 112; Fort Snelling, 3; Heron Lake, 1; Ortonville, 1; Tower, 6.

South Dakota: Vermilion, 2; Pierre, 2; Travere, 1; Flandreau, 4; Fort Sisseton, 18; Fort Wadsworth, 2.

Ontario: Toronto, 1; Lorne Park, 6.

MICROTUS PENNSYLVANICUS NIGRANS Rhoads. Albemarle Meadow Vole.

Microtus pennsylvanicus nigrans Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, 307-308.

Type locality.—Currituck, N. C.

Geographic distribution.—(Typical form.) Coast region of northern North Carolina and southern Virginia, in the Austroriparian zone.

Habitat.—Marshes and localities close to water.

General characters.—Slightly larger than *pennsylvanicus*, with noticeably larger hind feet and darker coloration.

Color.—*Summer pelage:* Upperparts dull bister, much obscured by black hairs; belly smoky gray to dull cinnamon; tail black above, sooty below; feet blackish. *Winter pelage* (partly retained in April specimens): Darker, with dorsal area almost black. *Young* (to nearly half grown): Sooty black all over.

Cranial characters.—Skull averaging slightly larger than in typical *pennsylvanicus;* rostrum slightly heavier, incisive foramina wider; dentition the same.

Measurements.—Average of three not fully adult males from type locality: Total length, 165; tail vertebræ, 48; hind foot, 23. *Skull* (No. 72374, ♂ ad., from Eastville, Va.): Basal length, 29; nasals, 8.5; zygomatic breadth, 17.5; mastoid breadth. 13.4: alveolar length of upper molar series, 7.3.

Remarks.—Specimens of *Microtus* from a chain of localities along the Atlantic coast, from North Carolina to Nova Scotia, show a decrease in size and intensity of coloration from the south northward. Unfortunately the type of *pennsylvanicus* was taken from an intermediate locality, and it becomes necessary to recognize the extremes—*acadicus* and *nigrans*—as slightly differentiated forms.

Specimens examined.—Total number of typical specimens, 16, from the following localities:

North Carolina: Currituck, 6.
Virginia: Wallaceton, 7; Eastville, 1; Smiths Island, 2.

MICROTUS PENNSYLVANICUS ACADICUS Bangs. Acadian Vole.

Microtus pennsylvanicus acadicus Bangs, Am. Nat., XXXI, 239–240, March, 1897.

Type locality.—Digby, Nova Scotia.

Geographic distribution.—Nova Scotia and Prince Edward Island.

Habitat.—Fields and fresh-water marshes.

General characters.—Slightly smaller than *M. pennsylvanicus;* color slightly paler, both in summer and winter.

Color.—Summer pelage (July to October): Upperparts yellowish bister, slightly lined with black hairs; belly washed with white or smoky gray; tail indistinctly bicolor, brownish black above, slightly paler below; feet dusky plumbeous. *Winter pelage:* Back buffy gray; sides paler; ears nearly concealed under bright ochraceous patch; belly washed with pure white; tail sharply bicolor, blackish above, white below; feet plumbeous. *Young:* Not so dark as those of *pennsylvanicus.*

Cranial characters.—Skull usually distinguishable from that of *pennsylvanicus* by projecting posterior point of palate; posterior tip of nasals slightly emarginate or truncate, never rounded. Dentition as in *pennsylvanicus.*

Measurements.—Type: Total length, 172; tail vertebræ, 49; hind foot, 20. Average of 5 topotypes: 170; 47; 21. *Skull* (No. 2145, ♂—not fully adult): Basal length, 25.5; nasals, 7.7; zygomatic breadth, 14.8; mastoid breadth, 12; alveolar length of upper molar series, 6.5.

Remarks.—None of the 19 topotypes before me are old, and the majority are not fully adult, but in a series of 40 specimens from Prince Edward Island, including fully adult specimens in both summer and winter pelages, the principal characters of *M. acadicus* are accentuated. The winter pelage is rather more distinctive than the summer.

Specimens examined.—Total number, 67, from the following localities:

Nova Scotia: Digby, 19; Halifax, 1.
Prince Edward Island: 47.

MICROTUS PENNSYLVANICUS MODESTUS (Baird). Sawatch Vole.

Arvicola modesta Baird, Mamm. N. Am., 535–536, 1857.
Arvicola insperatus Allen, Bul. Am. Mus. Nat. Hist., 347, 1894 (Custer, S. Dak.).

Type locality.—"Sawatch Pass, Rocky Mountains" [same as Cochetopa Pass], Colorado.

Geographic distribution.—Rocky Mountains and western Plains from New Mexico to British Columbia, and from the Black Hills of South Dakota to central Idaho, and beyond, with slight variation, to the plains of the Columbia, mainly in Transition zone.

Habitat.—Marshes and damp grassy places.

General characters.—Size of *M. pennsylvanicus*, tail slightly shorter, color paler, more yellowish, never chestnut in summer pelage; skull heavier, becoming more ridged and angular with age.

Color.—*Summer pelage:* Upperparts dull ochraceous, darkened with black-tipped hairs; belly washed with soiled whitish, smoky gray or pale cinnamon; feet plumbeous; tail indistinctly bicolor, blackish above, dull grayish below. *Winter pelage:* Much darkened above by long black hairs, especially early in the season, later becoming paler than in summer as the under-fur grows longer; belly heavily washed with creamy white; feet paler; tail more sharply bicolor. *Young:* Slightly less blackish than in *pennsylvanicus.*

Cranial characters.—Skull not positively distinguishable from that of *pennsylvanicus*, but in adults averaging heavier and more ridged.

Measurements.—Average of 10 adults from Cochetopa Pass, Colorado: Total length, 176; tail vertebræ, 44; hind foot, 20.6. *Skull* (No. 48053, ♀ ad.): Basal length, 27; nasals, 7.6; zygomatic breadth, 16; mastoid breadth, 12.4; alveolar length of upper molar series, 6.7.

Remarks.—Baird's type of *modestus* was collected at Sawatch or Cochetopa Pass in the Cochetopa Mountains. The type specimen in the United States National Museum is a half-grown young in the black pelage, and agrees perfectly in both external and cranial characters with specimens of the same age since collected at the type locality. The other specimen from Sawatch Pass (No. 593), which Professor Baird examined and believed to be distinct from *modestus*, but refrained from describing from a single immature specimen,[1] is also in the United States National Museum, and proves to be *Microtus nanus*, a good series of which has since been collected at a point 3 miles east of Cochetopa Pass. *Microtus mordax* is the only other species known to occur in this part of Colorado. These three widely different species are readily distinguishable at any age.

Microtus modestus decreases in size to the northward until, in northwestern Montana, it seems to merge into the little *drummondi* of the region farther north. Westward it becomes darker, specimens from Salt Lake Valley, Utah, being practically indistinguishable from typical *pennsylvanicus*, while those from Cœur d'Alene, Idaho, and the plains of the Columbia in eastern Washington are too small and dark to be typical *modestus*.

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[1] Mamm. N. Am., p. 535, 1857.

Specimens examined.—Total number, 259, from the following localities:

Colorado: Cochetopa Pass, 89; Fort Garland, 15; Loveland, 7; Twin Lakes, 1.
Wyoming: Newcastle, 1; Bear Lodge Mountains, 2; Sundance, 1; Lower Geyser Basin, Yellowstone Park, 1.
South Dakota: Custer, 2; Hill City, 1.
North Dakota: Fort Buford, 1.
Montana: Little Bighorn River, 2; Fort Custer, 3; Bozeman, 2; Fort Ellis, 1; Big Snowy Mountains, 13; Philbrook, 1; Stanford, 1; Choteau, 1; Robare, 1; Blackfoot, 1; Fort Assinniboine, 1; Tobacco Plains, 3; Stillwater Lake, 8; Flathead Lake, 9; Little Bitterroot Creek, 2; Hot Springs Creek, 1; Horse Plains (8 miles east), 1.
Idaho: Lemhi, 1; Salmon River, 3; Challis, 3; Birch Creek, 24; Cœur d'Alene, 3; Fort Sherman, 1.
Washington: Marshall, 15; Coulee City, 4; Conconully, 4; Colville, 20; Marcus, 1.
Utah: Ogden, 7; Salt Lake, 1.

MICROTUS PENNSYLVANICUS FONTIGENUS (Bangs). Forest Vole.

Microtus fontigenus Bangs, Proc. Biol. Soc. Wash., X, 48–49, March 9, 1896.
Microtus pennsylvanicus fontigenus Miller, Proc. Boston Soc. Nat. Hist., XXVIII, 14, April, 1897.

Type locality.—Lake Edward, Quebec.

Geographic distribution. Eastern Canada, in the Hudsonian zone.

Habitat.—Marshes, fields, dry banks, and deep woods.

General characters.—Smaller than *pennsylvanicus*, with short wide skull, large round bullæ, and short incisive foramina.

Color.—*Autumn pelage* (September specimens in long fur): Upperparts dark bister mixed with black, slightly paler on sides and cheeks; belly washed with whitish or smoky gray; tail bicolor, blackish above, grayish below; feet plumbeous.

Cranial characters.—Skull light and smooth, not ridged or angular; rostrum and incisive foramina short; braincase wide; audital bullæ large and smoothly rounded; interpterygoid space narrow, ending squarely at palate; dentition as in *pennsylvanicus*.

Measurements.—Type, ♀ ad.: Total length, 151; tail vertebræ, 41; hind foot, 21. Topotype, ♂ ad.: 150; 45; 21. *Skull* (No. 3839, ♂): Basal length, 23, nasals, 6.2; zygomatic breadth, 14.3; mastoid breadth, 11.5; alveolar length of upper molar series, 6.

Remarks.—The short rostrum, short, wide braincase, and short incisive foramina distinguish *fontigenus* from both *pennsylvanicus* and *drummondi*, with both of which species it seems to intergrade.

In size it is intermediate, and in external characters not very different from either. It is recorded by Mr. Miller from Nepigon and Peninsula Harbor, Ontario, but he considers the specimens obtained at those places not quite typical.[1] A series of 10 specimens from Godbout, Quebec, are rather nearer *fontigenus* than *acadicus*.

Specimens examined.—Total number, 6, topotypes (from the Bangs Coll.).

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[1] Proc. Boston Soc. Nat. Hist., XXVIII, 14, April, 1897.

MICROTUS PENNSYLVANICUS LABRADORIUS Bailey. Little Labrador Vole.

Microtus pennsylvanicus labradorius Bailey, Proc. Biol. Soc. Wash., XII, 88, April 30, 1898.

Type locality.—Fort Chimo, Ungava, Labrador.

Geographic distribution.—Known only from the type locality.

General characters.—Size of *Microtus drummondi* and of approximately the same proportions. Skull flatter, with smaller audital bullæ and more protruding upper incisors.

Color.—(Much changed by alcohol.) Upperparts dark brownish; belly whitish; tail bicolor; feet pale.

Cranial characters.—Skull low, not much ridged or angled; postorbital ridge prominent; nasals short, cuneate and scarcely reaching base of incisors; audital bullæ small; incisive foramina short; first upper molar usually with an inner posterior point, molar pattern otherwise as in *pennsylvanicus.* The skull is readily distinguishable from that of either *drummondi* or *fontigenus* by the protruding incisors and small audital bullæ.

Measurements.—Type, ♀ ad. (in alcohol), measured by Dr. C. Hart Merriam: Total length, 139; tail vertebræ, 39; hind foot, 20. Average of 7 alcoholic specimens from type locality: 137; 37; 19. *Skull* (of type): Basal length, 24.3; nasals, 6.7; zygomatic breadth, 14.4; mastoid breadth, 11; alveolar length of upper molar series, 6.2.

Remarks.—*M. labradorius* shows closer affinity with *drummondi* than with *fontigenus*, though no doubt meeting and grading into the latter. It is widely different from *enixus*, and the two occur together at Fort Chimo.

Specimens examined.—Total number, 9, from the type locality.

MICROTUS DRUMMONDI (Aud. & Bach.). Drummond Vole.

Arvicola drummondi Aud. and Bach., Quad. N. Am., III, 166–167, 1854.

Arvicola (*Mynomes*) *microcephalus* Rhoads, Proc. Acad. Nat. Sci. Phila., 1894, 286–287 (Lac La Hache, B. C.).

Microtus stonei Allen, Bul. Am. Mus. Nat. Hist., XII, 4, March, 1899 (Liard River, N. W. T.).

Type locality.—Rocky Mountains, vicinity of Jasper House, Alberta.

Geographic distribution.—From Hudson Bay to the west slope of the Rocky Mountains and Alaska, and from the northern edge of the United States north to Fort Anderson, N. W. T., in Canadian and Hudsonian zones.

Habitat.—Both marshes and dry upland.

General characters.—Similar to *Microtus pennsylvanicus*, but much smaller, with slenderer feet and tail, and paler color.

Color.—*Summer pelage:* Upperparts yellowish bister with numerous dark-brown- or black-tipped hairs, sides of nose and hairs in front of ears more decidedly yellowish; belly white or rarely tinged with buffy, sometimes dusky during the molt; feet silvery gray; tail bicolor, blackish above, whitish below. *Winter Pelage:* Paler than in summer; yellow on ears and nose more conspicuous; *Young:* Paler and not so sooty as young *pennsylvanicus.*

Cranial characters.—Skull not much arched and rather flat topped, slender but sharply ridged in adults; audital bullæ large and smoothly rounded; palate flattened in immature specimens, becoming higher with deep lateral pits in adults. Dentition as in *pennsylvanicus.* Except for the larger bullæ and a few characters of minor weight, the skull of *drummondi* is a miniature of the skull of *pennsylvanicus.*

Measurements.—Average of 6 adult males and females from Muskeg Creek, Alberta: Total length, 145; tail vertebræ, 39; hind foot, 17.8. Largest specimen from Muskeg Creek: 160; 41; 18. *Skull* (No. 81487, ♀ ad., same locality): Basal length, 23; nasals, 6; zygomatic breadth, 14; mastoid breadth, 11; alveolar length of upper molar series, 6.

Remarks.—The characters separating *drummondi* from *pennsylvanicus* and *modestus* are relative. There is no sharp distinction and the forms either merge into each other, or after approaching each other in size overlap in range and occur together at the same localities. Specimens from Blackfoot, Montana, are nearer *modestus*, while those from Summit and St. Marys Lake are almost typical *drummondi.* At Elk River, Minnesota, about half of the specimens are almost typical *drummondi*, while the others are a small form of *pennsylvanicus;* but, as others fall between and cannot positively be placed with either form, it is impossible to decide whether the difference is due to individual variation in an intermediate form or whether two species meet and interbreed.

To the eastward *drummondi* merges into *fontigenus*, from which it differs in such slight degree that the two are not easily distinguishable. On the west slope in British Columbia *drummondi* becomes slightly darker, and in that respect less unlike *fontigenus* in appearance, but retains its cranial characters, Alaska and northwestern specimens (from Fort Wrangel, Nulato, and Fort Simpson) are larger and in general appearance less different from *pennsylvanicus*, but detailed cranial characters show them to be but a robust form of *drummondi.* Specimens from Liard River, including the type of *M. stonei*, are indistinguishable from typical *drummondi.*

Specimens examined.—Total number, 355, from the following localities:

Alberta: Muskeg Creek (15 miles south of Smoky River), 13; Smoky Valley (50 miles north of Jasper House), 5; Fishing Lake (90 miles north of Jasper house), 2; Henry House (15 miles south), 4; South Edmonton, 110; St. Alberts, 26; Canmore, 2; Banff, 1; Red Deer, 1.
Athabasca: Lesser Slave Lake, 1.
Assiniboia: Indian Head, 30; Medicine Hat, 1.
British Columbia: Shuswap, 13; Sicamous, 1; Cariboo Lake, 2; Okanagan, 11; Ducks, 2; Stuart Lake, 1.
Saskatchewan: Cumberland House, 2; St. Louis, 1.
Manitoba: Carberry, 2.
Ontario: Rat Portage, 2; Coney Island (Lake of the Woods), 2.
Northwest Territory: Fort Churchill, 2; Fort Simpson, 2; Fort Rae, 3; Fort Reliance, 1; Big Island (Great Slave Lake), 1; Fort Good Hope, 1; Fort MacPherson, 1; Fort Anderson, 2; head of Liard River, 1; Chandindu River, 1; Dawson, 1; Sixty-Mile Creek, 1; Fort Selkirk, 3; 50 miles below Fort Selkirk, 1; Rink Rapids, 6; Thirty-Mile River, 3; Lake Lebarge, 4; Fifty-Mile River, 6; Lake Marsh, 22; Caribou Crossing, 16.

Alaska: Fort Wrangell, 1; Nulato, 1; Charlie Creek (Yukon River), 2; Canadian Boundary and Yukon River, 4.
North Dakota: Portland, 4; Lisbon, 1; Bottineau, 1.
Montana: St. Marys Lake, 6; Summit, 8.
Idaho: Priest Lake, 5.
Washington: Loon Lake, 9.

MICROTUS AZTECUS (Allen). Aztec Vole.

Arvicola (*Mynomes*) *aztecus* Allen, Bul. Am. Mus. Nat. Hist., V, 73–74, April 28, 1893.

Type locality.—Aztec, New Mexico (altitude, 5,900 feet).

Geographic distribution.—Valley of the San Juan River in northwestern New Mexico, in Transition zone.

Habitat.—Grassy places along the river banks and near irrigation ditches.

General characters.—In size similar to *M. pennsylvanicus*, but with shorter tail and larger hind foot; skull long; braincase narrow; interparietal long.

Color.—*Winter pelage:* Upperparts dull buffy, heavily mixed with black hairs; belly washed with creamy or pale buff; feet plumbeous; tail sharply bicolor, black above, soiled whitish below. *Young* (half-grown specimens in Dec.): Scarcely different in color from adults. (*Summer pelage* not examined.)

Cranial characters.—Skull long; braincase high and narrow; interparietal more than half as long as wide, extending back to plane of foramen magnum; audital bullæ large; mandible short and heavy; angular process of mandible wide; dentition as in *pennsylvanicus.*

Measurements.—Average of 7 adults from type locality: Total length, 171; tail vertebræ, 43; hind foot, 22. *Skull* (No. 57432, ♂ ad.): Basal length, 28.8; nasals, 8.4; zygomatic breadth, 17; mastoid breadth, 12.5; alveolar length of upper molar series, 7.2.

Remarks.—*Microtus aztecus* belongs to the *pennsylvanicus* group. Externally it is not very different from *modestus*, but none of the specimens show any signs of intergradation; and the skull characters are so well marked that there seems no doubt of its full specific rank.

Specimens examined.—Total number, 45, from the following localities:

New Mexico: Aztec, 42; La Plata, 3.

MICROTUS ENIXUS Bangs. Large Labrador Vole.

Microtus enixus Bangs, Am. Nat., XXX, 1051–1052, Dec. 5, 1896.

Type locality.—Hamilton Inlet (north shore), Labrador.

Geographic distribution.—Eastern coast of Labrador from Hamilton Inlet to Ungava Bay, in Hudsonian zone.

General characters.—Size slightly larger than *M. pennsylvanicus*, with relatively longer tail and larger ears; coloration duller and darker; skull smaller, shorter, and wider, with lighter molars. Hip glands present in adult males.

Color.—Summer pelage (July and Aug. specimens): Upperparts dark yellowish bister mixed with blackish; belly smoky gray or soiled whitish, sometimes tinged with buffy; feet dusky or blackish; tail black above, grayish brown below.

Cranial characters.—Outline of skull shorter, wider, and less arched than in *pennsylvanicus*; prezygomatic notch deep; coronoid notch of mandible wide and rounded; molar series small and slender; $\underline{m2}$ with posterior loop completely closed and circular in form; $\underline{m3}$ with terminal loop shortened; dentition otherwise as in *pennsylvanicus*.

Measurements.[1]—Type, ♀ ad.: Total length, 210; tail vertebræ, 67; hind foot, 22.5. Average of 10 adult topotypes: 189.4; 60.4; 22.4. *Skull* (No. 4018, ♀ ad.): Basal length, 27.3; nasals, 8.6; zygomatic breadth, 16.7; mastoid breadth, 12.3; alveolar length of upper molar series, 6.5.

Remarks.—Microtus enixus appears to be a distinct and well marked species of the *pennsylvanicus* group, the long tail and small molars being the most convenient characters for recognition. From its geographically nearest neighbors, *Microtus p. fontigenus*, of Lake Edward, Quebec, and *Microtus p. labradorius*, of Ungava, it shows a wider difference than from typical *pennsylvanicus*.

Specimens examined.—Total number, 16, from the following localities:

Labrador: Hamilton Inlet, 13; Fort Chimo, Ungava, 3.

MICROTUS TERRÆNOVÆ (Bangs). Newfoundland Vole.

Arvicola terrænovæ Bangs, Proc. Biol. Soc. Wash., IX, 129–132, July 27, 1894.

Type locality.—Codroy, Newfoundland.

Geographic distribution.—Newfoundland and Penguin Island.

General characters.—Slightly larger than *pennsylvanicus*, with decidedly larger hind foot, and more yellowish colors; belly with dusky median line; nose patch buffy; skull wide and angular.

Color.—Summer pelage (in July and August specimens): Upperparts dark russet, darkened by brown-tipped hairs, becoming paler on sides and across face; nose patch dark buffy or dull russet; belly whitish or smoke gray with a median streak of dusky cinnamon; tail distinctly bicolor, blackish above, soiled whitish below; feet grayish brown. *Winter pelage* (retained in April specimens): Slightly paler russet above, whiter below, with sharper markings throughout. *Young* (nearly half-grown): Similar to adults.

Cranial characters.—Skull short with wide-spreading zygomata; prezygomatic notch deep; nasals terminating even with arms of premaxillæ; lateral pits of palate deep and wide; interpterygoid space narrow with median constriction; $\underline{m1}$ with an anterior spur or loop; $\overline{m3}$ with posterior loop short, irregularly rounded, triangular or trifoliate; $\overline{m2}$ and $\overline{m3}$ normally with anterior point or spur.

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[1] From original description.

Measurements.—Average of 10 adults from type locality: Total length, 182; tail vertebræ, 52; hind foot, 23.4. *Skull* (No. 74029, ♂ ad.): Basal length, 28.5; nasals, 8.4; zygomatic breadth, 17; mastoid breadth, 13; alveolar length of upper molar series, 7.

Remarks.—*Microtus terrænovæ* shows very distinctive characters, and no close affinity with any neighboring species. Specimens showing very young and full winter pelage are still needed for a comprehensive description

Specimens examined.—Total number, 43; from the following localities:

Newfoundland: Codroy, 35; Penguin Island, 8.

MICROTUS BREWERI (Baird). Beach Vole.

Arvicola breweri Baird, Mamm. N. Am., 525–526, 1857.

Type locality.—Muskeget Island, Massachusetts.

Geographic distribution.—Muskeget Island.

Habitat.—Beach plum thickets on the sandy island.

General characters.—Size a little larger than *pennsylvanicus;* colors pale grayish; pelage long and coarse; skull heavy with wide nasals and quadrate interparietal.

Color.—*Summer pelage* (July 18): Upperparts buffy gray with scattered brown- and black-tipped hairs, paler on sides; belly tinged with sulphur yellow; feet silvery gray; tail bicolor, rusty brown or blackish above, soiled whitish below. *Young:* Rather paler and duller than adults.

Cranial characters.—Skull massive; nasals wide anteriorly; interparietal more than half as long as wide; inner edges of zygomata sharply notched close to lachrymals; rostrum heavy; upper incisors bent abruptly downward; molar pattern not very different from that of *pennsylvanicus.*

Measurements.—Average of 10 adults from Muskeget Island: Total length, 182; tail vertebræ, 54; hind foot, 22.3. *Skull* (No. 73141, ♂ ad.): Basal length, 28.7; nasals, 8.3; zygomatic breadth, 17.3; mastoid breadth, 13; alveolar length of upper molar series, 7.2.

Remarks.—Nine of the 26 specimens have a small white spot on the forehead. This may be accidental or an only partially acquired character.

Specimens examined.—Total number, 26; all from the type locality.

MICROTUS NESOPHILUS Bailey. Gull Island Vole.

Microtus insularis Bailey, Proc. Biol. Soc. Wash., XII, 86, April 30, 1898. Name preoccupied by *Lemmus insularis*, Nillson (= *Microtus agrestis* L.).
Microtus nesophilus Bailey, Science, N. S., VIII, 782, Dec. 2, 1898.

Type locality.—Great Gull Island, New York.

Geographic distribution.—Great Gull Island (at entrance to Long Island Sound).

General characters.—Size of *pennsylvanicus;* colors darker; skull shorter and wider with more spreading zygomata and deeper prezygomatic notches.

Color.—Summer pelage: Upperparts, dark yellowish bister heavily mixed with black hairs, darkest on nose and face; belly dusky, washed with cinnamon; feet blackish; tail blackish above, dark brown below.

Cranial characters.—The skull differs from that of *pennsylvanicus* in shorter, wider braincase, wider and more abruptly spreading zygomatic arches, more expanded jugal, and smaller audital bullæ; palate short, with a median point or spur and deep lateral pits; m3 normally with anterior inner and outer triangles approximately opposite and confluent; dentition otherwise similar to that of *pennsylvanicus.*

Measurements.—Type (measured in dry skin): Tail, 29; hind foot, 20. No. 1943, Am. Mus., ♂ ad., 185: 41: 21. *Skull* (No. 53969): Basal length, 26; zygomatic breadth, 16.2; mastoid breadth, 12.3; alveolar length of upper molar series, 6.8. (No. 1943) 26.6; 8.5; 16.2; 13; 6.6.

Remarks.—Microtus nesophilus needs no comparison with *breweri* or *terrænovæ,* the other two insular forms from the Atlantic coast. In general appearance it more nearly resembles *pennsylvanicus,* but in cranial characters it is as distinctly different as either of the other island species.

During the month of August, 1898, Mr. A. H. Howell visited Great Gull Island for the purpose of getting specimens of *Microtus,* but he found their old haunts covered by the earth moved in grading the island for fortifications, while no trace of the animals remained. He thinks they are completely exterminated.

Specimens examined.—Total number, 15; all from the type locality.

MICROTUS MONTANUS (Peale). Peale Vole.

Arvicola montanus Peale, U. S. Exploring Exp'd., Mammalogy, 44, 1848.
Arvicola longirostris Baird, Mamm. N. Am., 530–531, 1857. (From upper Pitt River, California.)

Type locality.—Headwaters of Sacramento River, near Mount Shasta, California.

Geographic distribution.—Northeastern California, eastern Oregon, northern Utah and Nevada, in the Upper Sonoran and Transition zones.

Habitat.—Marshes, meadows, and tule swamps.

General characters.—Size medium (about as in *pennsylvanicus*); tail about twice as long as hind foot; colors dark; hip glands conspicuous in adult males; incisors projecting well in front of nasals; incisive foramina narrow and constricted posteriorly.

Color.—Summer pelage: Upperparts bister or ashy mixed with blackish; belly washed with soiled whitish, giving a smoky gray or dusky color; feet plumbeous; tail indistinctly bicolor, blackish above, plumbeous below; lips usually showing a trace of whitish.

Cranial characters.—Skull generally slender and smooth, becoming angular and ridged in only a few very old individuals; nasals narrow and short; interparietal wide and normally strap-shaped; incisive foramina narrow and constricted posteriorly; bullæ medium and well rounded; dentition rather light; m2 with 4 closed sections; m3 with 3 closed triangles; m1 normally with 5 closed triangles.

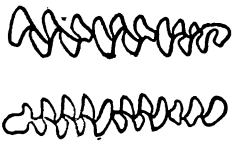

FIG. 2.—Molar enamel pattern of *Microtus montanus* (×5).

Measurements.—Average of 10 specimens from Sisson, Cal.: Total length, 175; tail vertebræ, 52; hind foot, 21.5. Extremely large specimens from Sisson run as high as 192; 54; 23. *Skull* (No. 98689, ♂ ad., from Sisson): Basal length, 28; nasals, 8; zygomatic breadth, 17; mastoid breadth, 13.5; alveolar length of upper molar series, 7.3.

General remarks.—The original description of *M. montanus*, though meager, agrees in all particulars with the animal from Sisson, at the west base of Mount Shasta. The measurements (total length, 6⅛ inches; tail, 1½ inches=156 mm. and 38 mm.) give it too short a tail, which only serves to restrict it more closely to this form in distinction from either of the longer-tailed species (*mordax* or *californicus*) that occur at or near the type locality. Three mounted specimens in the United States National Museum, which Baird referred to *montanus*,[1] and which came from Upper Klamath Lake and the Upper Des Chutes, are identical with those of the present series from Sisson, Fort Klamath, and Fort Crook. Specimens from the south end of Goose Lake, which is the source of Pitt River, are the same as those from Sisson and from Fort Crook, lower down the river, and also the same as Baird's type of *M. longirostris* from 'Upper Pitt River.'

M. montanus has a somewhat scattered and interrupted distribution and shows considerable geographic variation in widely separated localities. The extreme development of large size, large feet, and heavy angular skull is found in the big marshes of the Carson Sink, Nevada, while specimens from higher levels in the Transition zone are smaller, with slenderer feet and grayer coloration. The variation is mainly, but not entirely, zonal. To separate either extreme would tend to confusion rather than convenience, as the extremes point to *nevadensis* on the one hand and to *nanus* on the other.

Specimens examined.—Total number, 263, from the following localities:

California: Sisson, 57; Fort Crook, 23; Hayden Hill, 2; Fall Lake, 2; Cassel, 1; Tule Lake, 2; Goose Lake, 8; Greenville (8 miles NW.), 3; Bucks Ranch (Plumas Co.), 1; Quincy, 3; Summit, 1.

Nevada: Washoe, 1; Deep Hole (south end of Granite Range), 1; Pine Forest Range, 1; Mountain City, 4; Wells, 13; Austin, 7; Carson, 16; Stillwater, 10; Newark Valley, 5; Monitor Valley, 5; Ruby Lake, 5; Ruby Mountains, 3.

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[1] Mamm. N. Am., 530, 1857.

Oregon: Klamath Basin (Lost River), 8; Klamath Falls, 1; Fort Klamath, 5; Swan Lake Valley, 5; Plush (west side Warner Lake), 9; Shirk, 2; Steen Mountains (east slope), 1; Summit NE. of Steen Mountains), 2; Burns, 2; Wapinitia, 4.

Utah: Ogden, 16; Salt Lake City, 3; Provo, 1; Fairfield, 10; Manti, 20.

MICROTUS MONTANUS ARIZONENSIS Bailey. Arizona Vole.

Microtus montanus arizonensis Bailey, Proc. Biol. Soc. Wash., XII, 88, April 30, 1898.

Type locality.—Springerville, Ariz.

Geographic distribution.—Plateau country of eastern Arizona, at head of Little Colorado, in the Transition Zone.

Habitat.—Creek banks and damp meadows.

General characters.—Similar to *M. montanus*, but brighter and more ferruginous in color; lateral pits of palate shallower.

Color.—*Early winter pelage* (October and November specimens): Upperparts yellowish or rusty brown; belly washed with white; feet dark grayish; tail bicolor, blackish above, grayish below; lips whitish. Slightly immature specimens are a little duller colored than adults.

Cranial characters.—Skull very similar to that of *montanus*, but easily distinguished by the flatter palate with shallower lateral pits and by thicker pterygoids; condyloid process of mandible slightly shorter. Dentition not different.

Measurements.—Type: Total length, 184; tail vertebræ, 55; hind foot, 20. Average of 7 specimens from type locality: 158; 41; 20.6. *Skull* (of type): Basal length, 27.3; nasals, 8; zygomatic breadth, 16; mastoid breadth, 12.2; alveolar length of upper molar series, 6.5.

General remarks.—Although widely separated geographically from *M. montanus* by desert country through which continuity of range is improbable, this form is so closely related to that species that its position is best indicated by subspecific rank.

Specimens examined.—Total number, 12, from the following localities:

Arizona: Springerville, 11.

New Mexico: Nutria, 1.

MICROTUS MONTANUS RIVULARIS Bailey. Utah Vole.

Microtus nevadensis rivularis Bailey, Proc. Biol. Soc. Wash., XII, 87, April 30, 1898.

Type locality.—St. George, Utah.

Geographic distribution.—Known only from type locality, probably restricted to Lower Sonoran zone.

Habitat.—Tule marshes along the banks of the Virgin River. The runways were always found in wet places among sedges and rushes.

General characters.—Larger and lighter colored than typical *montanus;* skull more arched; nasals narrower.

Color.—*Winter pelage:* Upperparts dull bister, darkened with blackish-tipped hairs; sides scarcely paler; belly washed with white; feet dull grayish; tail bicolor, blackish above, grayish below. *Young:* Darker than adult, but not black backed as in *nevadensis.*

Cranial characters.—Skull well arched, not much ridged; nasals conspicuously narrower than in *montanus;* frontals narrower posteriorly; basioccipital more constricted anteriorly; dentition essentially the same.

Measurements.—Type: Total length, 179; tail vertebræ, 48; hind foot, 23. A nearly adult female topotype: 163; 43; 21. *Skull* (of type): Basal length, 28.2; nasals, 8.3; zygomatic breadth, 17; mastoid breadth, 13.3; alveolar length of upper molar series, 7.3.

General remarks.—Since *rivularis* was described in 1898 as a subspecies of *nevadensis*, a series of 50 specimens has been collected at the type locality of *montanus*, showing for the first time the real characters and the range of variation in that species, and, moreover, as Dr. Merriam had previously suggested to me, that *rivularis* comes nearer to typical *montanus* than to *nevadensis.* So far as at present known it has an isolated range in a Lower Sonoran valley, but it may readily extend northward to meet and merge into *montanus* in central Utah.

Specimens examined.—Total number, 4, from the type locality.

MICROTUS NANUS (Merriam). Dwarf Vole.

Arvicola nanus Merriam, North American Fauna No. 5, 62–63, pl. II, figs. 5 and 6, July 30, 1891.

Type locality.—Pahsimeroi Mountains, Idaho (altitude 9,350 feet).

Geographic distribution.—Rocky Mountains and outlying ranges, from central Idaho southward to central Nevada and southern Colorado, in Canadian zone.

Habitat.—Dry, grassy parks on mountain slopes.

General characters.—Size small; tail short; ears short and rounded; color dark grayish; skull slender.

Color.—*Summer pelage:* Upperparts uniformly grizzled gray mixed with sepia and blackish hairs; belly washed with white; feet grayish or plumbeous; tail bicolor, dusky gray above, whitish below. (*Winter pelage* unknown.) *Young:* Similar to adult, but slightly duller throughout.

Cranial characters.—Skull small, slender and well arched, with slender zygomata and large well-rounded bullæ; superciliary ridges prominent, sometimes confluent in old age; incisors projecting well beyond nasals; molars light, with short, wide triangles; enamel pattern scarcely distinguishable from that of *mordax* and *montanus.*

Measurements.—Type, ♂ ad.: Total length, 151; tail vertebræ, 41; hind foot, 18. Average of five adults from type locality: 143; 37; 18.4. *Skull* (of type): Basal length, 23.7; nasals, 6.7; zygomatic breadth, 14; mastoid breadth, 10.8; alveolar length of upper molar series, 5.8.

Remarks.—*Microtus nanus* belongs to the *montanus* group but occupies a higher zone and has more of the habits of *Pedomys* or *Lagurus.* It is rarely found in wet places or near water. Specimens from certain isolated localities are not entirely typical, but do not differ enough to warrant separation.

Specimens examined.—Total number, 114, from the following localities:

Idaho: Pahsimeroi Mountains, 13; Lost River Mountains, 1; Challis, 7; Sawtooth Lake, 5; Three Creek, 3; Montpelier Creek, 3; Seven Devils Mountains, 4.
Utah: Uinta Mountains, head of Smith Fork, 1.
Wyoming: Fort Bridger, 9; Kinney Ranch, 6; Beaver, 1 (no skull); La Barge Creek (near head), 1; Cheyenne, 3; Sherman, 2; Laramie, 2; South Pass City, 20; Bighorn Mountains, head of Powder River, 9.
Montana: Beartooth Mountains, 3; Big Snowy Mountains, 1.
Colorado: Estes Park, 1; Cochetopa Pass, 17; Twin River, 1; Twin Lakes, 1.

MICROTUS NANUS CANESCENS Bailey. Gray Vole.

Microtus nanus canescens Bailey, Proc. Biol. Soc. Wash., XII, 87, April 30, 1898.

Type locality.—Conconully, Washington.

Geographic distribution.—Northern Washington and southern British Columbia, east of the Cascades. Apparently confined to the Transition zone.

Habitat.—Dry grassy ground.

General characters.—Like *nanus* but lighter, clearer gray; skull with larger bullæ and greater mastoid breadth; zygomatic arches less widely spreading; upper incisors bent more abruptly downward. Hip glands conspicuous in adult males.

Color.—*Summer pelage:* Upperparts clear, dark grayish, formed by pale buffy and black-tipped hairs; sides shading to lighter gray and belly to white; feet dark gray; tail bicolor, blackish above, grayish below. (*Young* and *winter pelage* not shown in present material.)

Cranial characters.—Skull slightly narrower and more elongate than in *nanus;* interparietal averaging longer; bullæ decidedly larger and fuller; mastoid breadth relatively greater; incisors scarcely reaching beyond nasals; molar pattern as in *nanus.*

Measurements.—Type: Total length, 149; tail vertebræ, 42; hind foot, 20. *Skull* (of type): Occipital condyle to anterior base of molars, 17.4; posterior tip of nasals to foramen magnum, 19.2; zygomatic breadth, 15; mastoid breadth, 12.3; alveolar length of upper molar series, 6.3.

General remarks.—In its extreme development this northern form is readily distinguishable from typical *nanus.* From intermediate localities, Flathead Lake and the Plains of the Columbia, specimens are not typical of either but show slight peculiarities of local development interesting in themselves but not sufficiently marked for even subspecific distinction. To a certain extent they are intermediate between *nanus* and *canescens.*

Specimens examined.—Total number, 47, from the following localities:

British Columbia: Okanagan, 11; Ducks, 2; Vernon, 7.
Washington: Conconully, 1; Wenatchee, 1; Fort Walla Walla, 1; Oakesdale, 2; Wawawai, 4; Cheney, 1.
Oregon: Elgin, 2; Wallowa Mountains (near Joseph), 6.
Montana: West arm of Flathead Lake, 5; Hot Spring Creek (a branch of the Little Bitterroot), 4.

MICROTUS CANICAUDUS Miller. Gray-tailed Vole.

Microtus canicaudus Miller, Proc. Biol. Soc. Wash., XI, 67–68, April 21, 1897.

Type locality.—McCoy, Oregon.

Geographic distribution.—Willamette Valley, Oregon, and the east base of the Cascades in southern Washington, in Transition zone.

General characters.—Size and proportions about as in *nanus;* ears larger, skull heavier, more arched, with fuller, rounder bullæ, and shallower lateral pits of palate, coloration more yellowish, tail grayer.

Color.—*Winter pelage:* Upperparts bright yellowish bister, darkened with blackish-tipped hairs, slightly paler on sides; belly and whole lower parts whitish-gray; feet grayish or pale plumbeous; tail in winter adults uniformly grayish, with a half-concealed dusky dorsal line. In the only *summer* specimen (from North Yakima, Wash., and perhaps not typical) the tail is sharply bicolor with a blackish dorsal line. *Young* (half-grown November specimens): Sooty gray above and scarcely lighter below; feet dusky; tail gray, with a blackish dorsal stripe.

Cranial characters.—Skull high, smooth, and well arched, with scarcely a trace of superciliary ridges; interparietal lozenge-shaped; bullæ larger and more rounded than in *nanus;* interpterygoid fossa narrower and more acuminate; lateral pits of palate shallower; incisors less protruding; enamel pattern of molars the same as in *nanus.*

Measurements.—Type: Total length, 135; tail vertebræ, 33; hind foot, 20. Average of 8 adults from type locality: 141; 35.7; 20. *Skull* (of type): Basal length, 24.2; nasals, 7.3; zygomatic breadth, 15.3; mastoid breadth, 12.8; alveolar length of upper molar series, 6.

Remarks.—A single specimen with a badly broken skull from North Yakima, Wash., seems to be true *canicaudus* in summer pelage, and indicates that the range of the species is much more extensive than is at present known.

Specimens examined.—Total number, 14, from the following localities:

Oregon: McCoy, 9; Beaverton, 2; Sheridan, 2 (im).
Washington: North Yakima, 1.

MICROTUS DUTCHERI Bailey, Dutcher Vole.

Microtus dutcheri Bailey, Proc. Biol. Soc. Wash., XII, 85, April 30, 1898.

Type locality.—Big Cottonwood Meadows, near Mount Whitney, California (altitude, 10,000 feet).

Geographic distribution.—Hudsonian zone of the southern Sierra Nevada.

Habitat.—Wet alpine meadows.

General characters.—Size rather small; tail short; ears small, nearly concealed by fur; colors dark above and below; lips and usually nose white; hip glands present in adult males.

Color.—*Summer pelage:* Upperparts dark bister with brown tips to the long hairs; below, dull cinnamon or buffy-brown; feet whitish or plumbeous-gray; tail bicolor, brown or blackish above, whitish below; lips and usually tip of nose white. (*Winter pelage* unknown.) *Young:* Dull brown above and scarcely lighter below; feet and tail blackish; lips and nose usually white.

Cranial characters.—Skull similar to that of *montanus* but differing in many details; rostrum slightly longer; bullæ smaller and less globular; lateral pits of palate shallower; dentition the same.

Measurements.—Type, ♂ ad.: Total length, 167; tail vertebræ, 35; hind foot, 20. Average of 10 adults, 5 males and 5 females, from type locality: 163; 37; 20.6. *Skull* (of type): Basal length, 27.4; nasals, 8; zygomatic breadth, 16.7; mastoid breadth, 12.2; alveolar length of upper molar series, 6.5.

General remarks.—The nearest relative of *M. dutcheri* is *montanus*, but the two species occupy widely separated zones, and show no evidence of intergradation.

Specimens examined.—Total number, 65, from the following localities in the Sierra Nevada:

California: Big Cottonwood Meadows, 28; Whitney Meadows, 11; Menache Meadows, 2; Olancha Peak, 3; Head of Kern River, 1; Mammoth, 12; Pine City, 3; Head of San Joaquin River, 5.

MICROTUS NEVADENSIS Bailey. Nevada Vole.

Microtus nevadensis Bailey, Proc. Biol. Soc. Wash., XII, 86, April 30, 1898.

Type locality.—Ash Meadows,[1] Nye County, Nevada.

Geographic distribution.—Known only from the type locality and Pahranagat Valley, about 100 miles to the northeast. Both localities are in the Lower Sonoran zone.

Habitat.—Salt grass and tule marshes in alkaline valleys. Runways always found in wet, muddy places, and often extending through shallow water.

General characters.—Size large; ears small; tail rather short; fur coarse and lax; colors dark; hip glands conspicuous in adult males. Skull massive and angular; incisive foramina narrow and closing to a point posteriorly.

Color.—*Winter pelage* (March specimens): Upperparts dark sepia or bister, much obscured by blackish hairs; sides lighter; belly smoky gray; feet dark gray; tail indistinctly bicolor, blackish above, gray or brownish below; lips usually white; tip of nose usually whitish. *Young:* With a blackish dorsal stripe and dusky feet and tail.

Cranial characters.—Skull heavy, angular, and much ridged; frontals high; rostrum bent downward; nasals truncate or rounded posteriorly, terminating even with arms of premaxillæ; incisive foramina short, rather narrow and constricted to a point posteriorly; dentition heavy; upper incisors curved abruptly downward; molar pattern variable; m2 with 4 closed sections in 8 out of 16 specimens, in the other 8, with a slight inner lobe or loop at base of posterior triangle; m3 with anterior crescent, three closed triangles, and a posterior loop with two inner lobes; m1 usually with 6 closed triangles.

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[1] Ash Meadows is on the Nevada side of the Nevada-California line near where the Amargosa River crosses the boundary. The exact locality is a big salt marsh below Watkins ranch.

Measurements.—Type: Total length, 210; tail vertebræ, 55; hind foot, 25.5. Average of 8 specimens from type locality: 176; 47; 23. *Skull* (of type): Basal length, 32; nasals, 10.2; zygomatic breadth, 19.3; mastoid breadth, 14.3; alveolar length of upper molar series, 8.

Remarks.—Three specimens taken May 26 in Pahranagat Valley differ slightly from the type series, but the cranial differences are slight and the darker color may be only seasonal. The species inhabits marshes and wet places, which are so rare and isolated in the desert region that it can have no extensive continuous range. It is one of the few forms of *Microtus* inhabiting a part of the Lower Sonoran zone.

Specimens examined.—Total number, 19, from the following localities:

Nevada: Ash Meadows, 16; Pahranagat Valley, 3.

MICROTUS CALIFORNICUS (Peale.) California Vole.

Arvicola californica Peale, U. S. Expl. Expd., Mammalogy, 46, 1848.
Arvicola trowbridgi Baird, Mamm. N. Am., 529, 1857. (Monterey, California.)

Type locality.—San Francisco Bay, California.

Habitat.—Dry meadows and grassy uplands, Upper Sonoran zone.

Geographic distribution.—California, west of the Colorado Desert and the Sierra Nevada, and from Santa Ysabel, San Diego County, Calif., north to the Rogue River and Umpqua valleys, Oregon.

General characters.—Size rather large, ears conspicuous above fur; pelage coarse and harsh, color similar to that of the house mouse; skull of adult heavy and angular, incisive foramina wide and open, usually widest posteriorly; a trace of hip glands in adult males.

Color.—*Summer pelage:* Upperparts dull buffy or clay-colored, slightly lined with blackish-tipped hairs; sides paler; belly light buffy or soiled whitish; tail bicolor, brownish above, buffy below; feet clear gray. *Winter pelage:* Much darker than the summer, with an excess of black-tipped hairs over the back; tail more sharply bicolor, blackish above. *Young:* Fur woolly and soft, duller and darker throughout than in the adult; belly dusky or plumbeous; feet and tail dusky.

Cranial characters.—Skull of adult heavy, angular, and ridged; nasals long, bent well down, widening abruptly in front, narrow and notched at posterior end, not reaching tip of ascending arm of premaxillæ; prezygomatic notch deep; postorbital processes prominent; frontals concave posteriorly; incisive foramina open, rounded at both ends and usually widest posterior to middle. Incisors heavy, the upper bent abruptly downward, not extending beyond tip of nasals; molars large and irregular, posterior triangle of m1 normally with an inner point or angle; posterior triangle of m2 with an inner point or angle or loop,[1] suggesting the posterior loop in *pennsylvanicus;* m3 with three closed triangles, 3 outer and 4 inner salient angles; m1 with 5 closed triangles and 9 or 11 salient angles.

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[1] In 100 specimens, 77 have 4 closed triangles in m2, 20 have an open posterior loop, and 3 have a closed posterior loop as in *pennsylvanicus*.

Measurements.—Average of 4 adults, 2 males and 2 females from Walnut Creek, Calif.: Total length, 171; tail vertebræ, 49; hind foot, 21.1. Of 10 adults from Monterey: 172; 52; 22.3. *Skull* (♂ ad., No. 44678, from Walnut Creek, Calif.): Basal length, 27.5; nasals, 8.5; zygomatic breadth, 16.6; mastoid breadth, 13.6; alveolar length of upper molar series, 6.8.

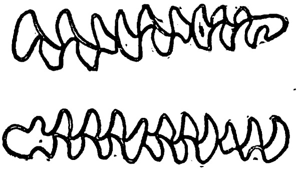

FIG. 3.—Molar enamel pattern of *Microtus californicus* (×5).

Remarks.—But slight variation is shown throughout the range of the species. Specimens from Santa Ysabel and the base of San Bernardino Mountains are indistinguishable from those of the shores of San Francisco Bay or from the Rogue River Valley, Oregon. A slight brightening in color is noticeable in specimens from Auburn.[1] The species is conspicuously absent from the bottom, or Lower Sonoran area, of the San Joaquin and Sacramento valleys, its place being taken in the tule marshes of these valleys by the larger, darker, longer-tailed species, *M. edax.*

The skin of the type of *M. californicus* in the United States National Museum agrees perfectly with series of specimens from Berkeley, Walnut Creek, and other localities around San Francisco Bay, but the slightly immature skull is either abnormal or else never came from the same animal as did the skin. By some error it was given the same catalogue number as the type skull of *M. occidentalis*, a synonym of *M. townsendi*, but it is not the skull of that species.

Specimens examined.—Total number, 338, from the following localities:

California: Walnut Creek, 6; Oakland, 1; Berkeley, 44; San Lorenzo, 3; San Mateo, 14; Novato, 7; Glen Ellen, 9; Nicasio, 16; Point Reyes, 34; Cape Mendocino, 2; Mill Valley, Marin County, 3; Olema, 5; Cloverdale, 14; Ukiah, 2; Laytonville, 2; Round Valley, 1; Upper Lake, 1; Leesville, 10; Bartlett Mountain, 1; Rio Dell, 1; Hornbrook, 3; Little Shasta, 4; Mayten, 2; Cassel, 6; Red Bluff, 1; near Edgewood, 2; Grindstone Creek, Tehama County, 2; Auburn, 5; Jackson, 7; Chinese Camp, 2; Boulder Creek, 2; Monterey, 22; Jamesburg, 12; Jolon, 4; San Simeon, 1; Paso Robles, 1; Morro, 4; Pozo, 1; Gaviota Pass, Santa Barbara County, 4; Santa Barbara, 2; Ventura River, 3; San Emigdio Canyon, Kern County, 7; Mount McGill, Ventura County, 2; Calabasas, 3; San Fernando, 4; San Bernardino, 2; San Bernardino Mountains, 9; San Diego, 1; Riverside, 5; Techelote Canyon, Riverside County, 1; Little Bear Valley (San Bernardino Mountains), 1; Las Virginias Creek, 1; Radec, Riverside County, 1; Santa Ysabel, 10; near Tejon Pass, 1; Fort Tejon, 1; South Fork Kern River, 6.

Oregon: Rogue River Valley (near Grants Pass), 7; Siskiyou, 4; Drain, 6.

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[1] The effect of red soil is noticeable in these as in some other mammals from the vicinity of Auburn.

MICROTUS CALIFORNICUS VALLICOLA Bailey. Valley Vole.

Microtus californicus vallicola Bailey, Proc. Biol. Soc. Wash., XII, 89, 1898.

Type locality.—Lone Pine, Inyo County, California.

Geographic distribution.—Valleys east of the Sierra Nevada, California. Confined mainly to Upper Sonoran zone.

Habitat.—Dry, grassy banks, upland meadows, and old weedy fields.

General characters.—Similar to *californicus*, but averaging slightly larger and darker. Proportions the same.

Color.—*Summer pelage:* Upperparts dull sepia, darkened by black-tipped hairs, darker and with less buffy suffusion than in *californicus;* belly dull grayish or smoky plumbeous; feet dusky; tail bicolor, blackish above, grayish below. *Winter pelage:* Darker throughout, with the black hairs of the back longer and more conspicuous. *Young:* Sooty gray above, plumbeous below, not black backed; feet and tail dusky.

Cranial characters.—Skull like that of *californicus*, but usually with smaller audital bullæ, more abruptly truncated occiput, and nasals reaching nearer to tips of premaxillæ; lobe at base of 4th triangle of middle upper molar sometimes developed into a loop.

Measurements.—Type, ♀ ad.: Total length, 200; tail vertebræ, 57; hind foot, 23. Average of 7 specimens from type locality: 188; 56; 23. *Skull* (of type): Basal length, 29.4; nasals, 9.5; zygomatic breadth, 17.6; mastoid breadth, 13.4; alveolar length of upper molar series, 7.4.

Remarks.—The range of this form is not widely separated from that of *californicus* on the west slope of the mountains, and the two forms may meet by way of Walker Pass and the South Fork of Kern River. The difference is not sufficiently marked to warrant full specific separation, in view of the fact that their ranges are so nearly continuous that they occupy the same zone and have essentially the same habits.

Specimens examined.—Total number, 52, from the following localities:

California: Lone Pine, 26; Olancha, 3; Cartago (west side of Owens Lake), 3; Independence Creek, 1; Alvord, 8; Bishop Creek, 2; Panamint Mountains (head of Willow Creek at east end of Nelson Range), 9.

MICROTUS CALIFORNICUS CONSTRICTUS subsp. nov. Coast Vole.

Type from Cape Mendocino, California. No. 98347, U. S. Nat. Mus., Biological Survey Collection. Collected Sept. 6, 1899, by Vernon Bailey. Original number, 7174.

Geographic distribution.—Coast region near Cape Mendocino.

Habitat.—Open grassy hillsides and old fields and pastures.

General characters.—Smaller and grayer than *californicus*, with narrower skull, smaller audital bullæ, and narrower interpterygoid fossa.

Color.—*Summer pelage* (in September specimens): Buffy gray above, whitish below; tail almost concolor, dull grayish; feet gray.

Cranial characters.—Skull smaller and especially narrower than that of *californicus*, with slender nasals and rostrum; bullæ small and narrow; pterygoids close together; zygomatic arches not abruptly spreading and not notched at anterior junction with premaxillæ; dentition as in *californicus;* tooth rows noticeably closer together.

Measurements.—Average of 4 adults from type locality: Total length, 163; tail vertebræ, 55; hind foot, 21.5. *Skull* (of type): Basal length, 26; nasals, 8.9; zygomatic breadth, 15.6; mastoid breadth, 12; alveolar length of upper molar series, 6.7.

General remarks.—There is a striking similarity in the characters separating this narrow-skulled form from its widely distributed species *californicus*, and those separating *angusticeps* of the coast region a little farther north from the still more widely distributed *mordax*, that shows an interesting parallelism in geographic modifications. Both forms are from the wind-beaten coast strip where arboreal vegetation is scanty and dwarfed, and, like some of the trees, they apparently represent depauperate forms of widely distributed and more protected inland species. At Capetown, just back of Cape Mendocino, California, I found *constrictus* in great abundance on the open grassy hills. In some places the ground was perforated with their burrows, while on the surface their runways crossed in all directions.

Specimens examined.—Four from the type locality, besides a large number in the flesh.

MICROTUS EDAX (Le Conte). Tule Vole.

Arvicola edax Le Conte, Proc. Acad. Nat. Sci. Phila., VI, 405, 1853.

Type locality.—California [south of San Francisco].[1]

Geographic distribution.—Bottom of the San Joaquin and Sacramento valleys, in Lower Austral zone.

Habitat.—Tule swamps and wet places, under heavy grass, where the runways usually extend through mud and water and in places are flooded by the tide.

General characters.—Size large; feet large and stout; hair long and coarse; skull long, angular, and much ridged in adults; hip glands inconspicuous or rudimentary in adult males.

Color.—*Winter pelage:* Much blacker than in *californicus;* gray of upperparts more or less obscured by black; that in full, ripe pelage is glossed with iridescent purple;[2] sides more grayish; belly washed with whitish; feet dusky; tail bicolor, black above and gray below or dusky gray above and whitish below. *Summer pelage:* Upperparts less glossed with black. *Young:* With black back, dusky sides, and paler dusky belly; feet and tail dark.

Cranial characters.—Skull similar to that of *californicus*, but larger, more elongated, more heavily ridged in adults, with more expanded jugal and heavier dentition; molar pattern similar; m2 with usually an open posterior fifth loop.

Measurements.—No. 58128, ♂ ad., from near Tracy, Calif.: Total length, 217; tail vertebræ, 72; hind foot, 25. An immature ♀ from the same place: 167; 49; 23. An adult ♂, No. 70602, from near Marysville Buttes: 208; 67; 25. *Skull* (No. 70602, ♂ ad.): Basal length, 30; nasals, 9.2;

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[1] Baird, Mamm. N. Am. 532, 1857.

[2] *M. californicus* and many other species show a purple gloss in high pelage, but less marked than in some specimens of *edax*.

zygomatic breadth, 17.7; mastoid breadth, 13.9; alveolar length of upper molar series, 7.8.

Remarks.—The type of *M. edax* in the United States National Museum, at Dr. Merriam's request, has been relaxed, the skull removed, and the skin made over and greatly improved for purposes of comparison. The base of the skull has been cut away, but enough remains to show that the specimen is immature and is the large swamp species, instead of *californicus*. The hind foot gives the only reliable measurement. In the dry skin it measures, flattened out, 23.5, and is proportionately stout. This is fully up to the flesh measurement of No. 57909 from Tracy, though the skull shows the latter to be slightly older.

M. californicus and *M. edax* differ widely in habits, their ranges conform to different zones, the distinctive characters are certainly strong enough for full specific recognition, and the present series shows no intergradation.

Specimens examined.—Total number, 50, from the following localities:

California: Tracy, 2; Marysville, 1; near Marysville Buttes, 1; Union Island (San Joaquin River), 1; Suisun, 21; Tulare Lake, 2; Mendota, 19.

MICROTUS SCIRPENSIS sp. nov. Desert Vole.

Type from Amargosa River (near Nevada line), Inyo County, Calif. No. $\frac{25972}{33385}$, ♀ ad., U. S. Nat. Mus., Biological Survey Collection. Collected February 26, 1891, by Vernon Bailey. Original number, 2520.

Geographic distribution.—Known only from the type locality.

Habitat.—Wet ground under tall tules (*Scirpus olneyi*), where the runways extend through mud and water in a little marsh around a warm spring.

General characters.—Size and proportions about as in *edax*, colors not so dark, tail long, skull heavy and angular, middle upper molar with rounded open or closed posterior loop.

Colors.—*Winter pelage:* Upperparts dark buffy gray, slightly darker than in *californicus*, but not so black as in *edax;* belly smoky gray, tail indistinctly bicolor, brown above, grayish below; feet brownish gray, not dusky. *Young:* Upperparts black, belly grayish, a black dorsal stripe retained until the animals are half grown.

Cranial characters.—Skull of adult angular and heavily ridged; in general characters resembling that of *edax*, but with more truncate posterior tip of nasals, heavier dentition, and well-developed inner posterior loop of middle upper molar. The same characters and larger size distinguish it from those of *vallicola* and *californicus*, and the wide incisive foramina with many other characters distinguish it from that of its nearest neighbor—*nevadensis*.

Measurements.—Type: Total length, 210; tail vertebræ, 67; hind foot, 25. Average of 6 adults: 203; 65; 25.1. *Skull* (of type): Basal length, 31; nasals, 10; zygomatic breadth, 19; mastoid breadth, 13.6; alveolar length of upper molar series, 8.7.

General remarks.—*Microtus scirpensis* stands nearest to *M. edax*, and, except for the more completely developed posterior loop of middle upper molar, fits into the *californicus* group. Among 14 specimens the loop is closed in 7 and open in 7, while among 43 specimens of *edax* it is closed in 2, open in 32, and absent in 9, and among 100 specimens of *californicus* it is closed in 3, open in 20, and absent in 77. Although resembling *pennsylvanicus* in the fifth loop, in other characters it does not approach that group or any of its forms. In range it comes nearer to *vallicola* than to *edax* or *californicus*, but from *vallicola* it differs in the same way as from *californicus*.

Specimens examined.—Total number, 14, from the type locality.

MICROTUS OPERARIUS (Nelson). Tundra Vole.

Arvicola operarius Nelson, Proc. Biol. Soc. Wash., VIII, 139, Dec. 28, 1893.

Type locality.—St. Michael, Alaska.

Geographic distribution.—Barren grounds from Bristol Bay, St. Michael, and Kowak River, Alaska, east to Anderson River.

Habitat.—Mossy tundras.

General characters.—Size small; tail short, densely haired; ears small and wholly concealed in long winter fur; colors yellowish; skull slender and narrow; dentition light.

Color.—*Winter pelage:* Upperparts dark rich buff, slightly tinged along back with black-tipped hairs; sides paler; belly pale buffy or creamy white; tail soiled whitish below and on sides, a partly concealed blackish dorsal line; feet gray; heels tinged with dusky. *Summer pelage:* Darker yellowish above, more buffy below.

Cranial characters.—Skull rather slender and narrow, angular and well ridged in adults; nasals slender, ending even with arm of premaxillæ; bullæ small and narrow; palate low; incisive foramina short, constricted posteriorly; incisors projecting well in front of nasals; molars very light; m2 with 4 closed sections; m3 with 3 closed triangles, 3 outer and 3 inner salient angles and terminal loop; m1 with 4 closed triangles, 3 outer and 5 inner salient angles, and fifth triangle open and confluent with short terminal loop, as in *M. ratticeps* of Europe.

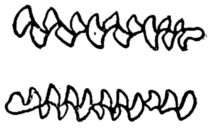

FIG. 4.—Molar enamel pattern of *Microtus operarius* (× 5).

Measurements.—Type (immature, measured in dry skin): Total length, 110; tail vertebræ, 28; hind foot, 18. Average of 10 adult topotypes, 168; 40; 19.7. *Skull* (of type): Basal length, 22.4; nasals, 5.8; zygomatic breadth, 12.4; mastoid breadth, 10.7; alveolar length of upper molar series, 5.5. Skull (of adult ♂, No. 9899): 27; 8; 16; 12.3; 6.3.

General remarks.—Mr. E. W. Nelson found these voles abundant along the coast tundras of Bering Sea from Cape Vancouver north to Bering

Strait, and on Nelson, St. Michael, and Stewart islands.[1] Mr. W. H. Osgood found them extending southward into the timbered region as far as the point where the Yukon crosses the Alaska boundary.

Specimens examined.—Total number, 81, from the following localities:

Alaska: St. Michael, 65; Kowak River, 1; Kagiktowik, 1; Bristol Bay, 1; Fort Yukon, 8; Circle, 1; 40 miles above Circle, 2; International boundary on Yukon, 1; Yukon River (200 miles southwest of Fort Yukon), 1.

MICROTUS MACFARLANI Merriam. Macfarlane Vole.

Microtus macfarlani Merriam, Proc. Wash. Acad. Sci., II, 24, March 14, 1900.

Type locality.—Fort Anderson, Anderson River, Northwest Territory.

Geographic distribution.—Tundra region of Arctic America, east of the Mackenzie River.

General characters.—Similar to *operarius* in external characters, but with shorter tail, shorter, wider skull and more projecting incisors. Fur very long and soft in winter specimens.

Color.—*Winter pelage:* Upperparts light buffy gray; belly whitish; feet silvery gray; tail sharply bicolor, black above, white below. *Summer pelage:* Darker and brighter buff or ochraceous. *Young:* More grayish.

Cranial characters.—Compared with *operarius:* Skull short and wide; nasals shorter; incisors more projecting; bullæ wider; incisive foramina shorter; molars slightly heavier; enamel pattern the same. With *yakutatensis:* Size smaller; coloration brighter; skull flatter; nasals shorter; incisors more projecting; interparietal smaller.

Measurements.—Type (in dry skin): Tail vertebræ, 29; hind foot, 18.5; topotype (No. 9144): tail, 27; hind foot, 19. *Skull* (of type): Basal length, 26; nasals, 7; zygomatic breadth, 15.5; mastoid breadth, 12.5; alveolar length of upper molar series, 6.

General remarks.—Material is so scanty from the Arctic regions that little is known of the range of this form, whether it meets and grades into *operarius* or *yakutatensis*, or whether it has a restricted and isolated range.

Specimens examined.—Total number, 18, from the following localities:

Northwest Territory: Fort Anderson, 4; Mackenzie River, 11; 'Arctic Coast,' 3.

MICROTUS YAKUTATENSIS Merriam. Yakutat Vole.

Microtus yakutatensis Merriam, Proc. Wash. Acad. Sci., II, 22. March 14, 1900.

Type locality.—Yakutat Bay (north shore), Alaska.

Geographic distribution.—Mainland of Alaska from Glacier Bay to Prince William Sound.

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[1] Proc. Biol. Soc. Wash., VIII, 140, 1893.

General characters.—Size medium, about equal to *operarius*, less than that of any of the island forms of the group. Color dusky, as in *sitkensis*, but belly whitish. Skull of adult male heavily ridged; bullæ medium, rounded; interparietal large, shield-shaped.

Color.—*Summer pelage:* Upperparts dusky gray, with a trace of brownish, darker dorsally; belly washed with soiled white or pale buffy; tail sharply bicolor, sooty or black above, whitish below; feet silvery gray, soles black. *Young:* Quarter-grown specimen (June 19), darker gray than adult, with black nape, whitish belly, sharply bicolor, black and white tail.

Cranial characters.—Skull heavy, ridged and angular in adult male; interparietal large, shield-shaped; nasals long, with median constriction; dentition heavy. From the skull of *operarius* it differs in greater width,. larger bullæ, heavier dentition; from that of *unalascensis* in smaller size, larger interparietal, slenderer nasals, smaller bullæ, shorter pterygoids. Molar pattern as in *operarius*. Skulls of adult females conspicuously smoother and less ridged than in males.

Measurements.—Average of 10 adults (5 males and 5 females) from type locality: Total length, 161; tail vertebræ, 37; hind foot, 20.6. *Skull* (of type, ♂ ad., No. 98005): Basal length, 28; nasals, 8; zygomatic breadth, 16; mastoid breadth, 13; alveolar length of upper molar series, 7.

General remarks.—This mainland form is readily distinguished from any of the island species of the group by either cranial or external characters, although it shows closer relationship with some of them than with the neighboring mainland species, *operarius*. If it has an uninterrupted range to the north it may grade into *operarius*, but at present there is no intermediate material to show whether it does or not.

Specimens examined.—Total number, 47, from the following localities:

Alaska: Yukutat, 29; Glacier Bay, 17; Prince William Sound, 1.

MICROTUS KADIACENSIS Merriam. Kadiak Vole.

Microtus kadiacensis Merriam, Proc. Biol. Soc. Wash., XI, 222, July 15, 1897.

Type locality.—Kadiak Island, Alaska.

Geographic distribution.—Known only from the type locality.

General characters.—Size about that of *sitkensis;* belly white; ears very small; bullæ small and narrow; basioccipital short and wide.

Color.—*Summer pelage:* Yellowish brown above, with scattered black hairs; sides paler; belly washed with pure white; feet silvery gray, heels dusky, soles blackish; tail not sharply bicolor, black above, whitish below. *Young* (in June): Dull buffy gray above, maltese below.

Cranial characters.—Skull flat, long, and narrow; audital bullæ small and laterally compressed; basioccipital short and wide; palate low, with sloping median ridge, lateral pits deeper, and incisive foramina wider than in *sitkensis;* nasals short, not reaching posterior tips of premaxillæ; incisors projecting; molars small; m3 with 3 closed triangles and elliptical terminal loop, making 3 inner and 3 outer salient angles, as in *operarius*.

Measurements.—Average of five adult males: Total length, 188; tail vertebræ, 50; hind foot, 21. *Skull* (of topotype, ♂ ad. No. 97969,): Basal length, 28; nasals, 8; zygomatic breadth, 16.5; mastoid breadth, 13.2; alveolar length of upper molar series, 6.4.

Remarks.—This insular species belongs to the *operarius* group, but differs from *operarius* in larger size, smaller bullæ, and transversely longer and narrower interparietal.

Specimens examined.—Total number, 12, from the type locality.

MICROTUS UNALASCENSIS Merriam. Unalaska Vole.

Microtus unalascensis Merriam, Proc. Biol. Soc. Wash., XI, 222, July 15, 1897.

Type locality.—Unalaska, Alaska.

Geographic distribution—Island of Unalaska.

General characters.—Larger and more robust than *operarius*; belly white; feet light gray; skull well arched and heavily ridged; bullæ large and well rounded.

Color.—Upperparts dull yellowish brown, darkest on head and rump; end of nose whitish; belly white or slightly soiled whitish; feet light gray with dusky soles; tail bicolor, a narrow line of blackish above, soiled white below. *Young:* Similar to adult.

Cranial characters.—Skull considerably arched, deep, heavy, and angular; frontals heavily ridged in old age; bullæ medium, much larger than in *operarius* or *kadiacensis*; basioccipital narrowly constricted between bullæ; dentition actually and relatively heavier than in *operarius*; molar pattern the same; $\underline{\text{m3}}$ with 3 closed triangles and an inner salient angle confluent with rounded posterior loop; m1 with 4 closed triangles, the fifth triangle confluent with shortened anterior loop.

Measurements.—Type, ♀ im.: Total length, 122; tail vertebræ, 28; hind foot, 19. Adult ♂ topotype, No. 97963: 181; 38; 22. *Skull* (of topotype): Basal length, 30; nasals, 8; zygomatic breadth, 17.7; mastoid breadth, 14; alveolar length of upper molars, 7.

Specimens examined.—Total number, 9, from the type locality.

MICROTUS UNALASCENSIS POPOFENSIS Merriam. Popof Island Vole.

Microtus unalascensis popofensis Merriam, Proc. Wash. Acad. Sci., II, 22, March 14, 1900.

Type locality.—Popof Island, Shumagin group, Alaska.

Geographic distribution.—Known only from Popof Island.

General characters.—Similar to *kadiacensis*, but slightly larger, with larger feet, relatively shorter and sharply bicolor tail. Skull less ridged, with larger bullæ and heavier molars. In size and proportions more nearly agreeing with *unalascensis*, from which it differs in wholly dusky nose, less ridged skull, smaller audital bullæ and deeper prezygomatic notch.

Color.—General coloration not readily distinguishable from that of *kadiacensis;* upperparts dark yellowish brown; nose dusky to tip; belly soiled white or pale buffy; tail sharply bicolor, whitish below, dusky or black above; feet silvery gray, with black soles and dusky heels.

Cranial characters.—Skull rather long and narrow; frontals not ridged in adults; prezygomatic notch deep; audital bullæ medium, not narrowly constricted as in *kadiacensis,* nor large and rounded as in *unalascensis;* palate with posterior point projecting into pterygoid fossa; incisive foramina short and wide; molar pattern as in *operarius* except in m3, which has normally 4 inner and 3 or 4 outer salient angles; m1 has 4 closed and 1 open triangle as in *operarius.*

Measurements.—Average of 3 topotypes: Total length, 165; tail vertebrae, 38; hind foot, 22.4. An adult ♀, No. 97959: 188; 43; 22. *Skull* (of type, No. 97956, ♂ ad.): Basal length, 29.4; nasals, 8.5; zygomatic breadth, 17.5; mastoid breadth, 13.5; alveolar length of upper molar series, 7.2.

General remarks.—This species needs comparison only with *unalascensis* and *kadiacensis,* from both of which it differs in slight external and well-marked cranial characters. The three are evidently from the same original stock that from long insular separation has been modified by somewhat varied conditions.

Specimens examined.—Total number, 7, from the type locality.

MICROTUS SITKENSIS Merriam. Sitka Vole.

Microtus sitkensis Merriam, Proc. Biol. Soc. Wash., XI, 221, July 15, 1897.

Type locality.—Sitka, Alaska.

Geographic distribution.—Known only from Baranof Island, Alaska.

General characters.—Size medium, about that of *unalascensis;* color yellowish brown above and below; skull rather flat, wide interorbitally; interparietal triangular; molars small; m1 with 4 or 5 closed triangles.

Color.—*August pelage:* Upperparts rusty brown, brightest on rump and nose, besprinkled with blackish hairs; sides paler; belly washed with dark buff; nose blackish; feet silvery plumbeous; heels and soles black; tail sharply bicolor, black above, pale buff below.

Cranial characters.—Skull long and flat, with no trace of superciliary ridges, wide interorbitally; tip of nasals reaching back of premaxillæ; interparietal narrow, subtriangular; bullæ medium and globose; palate long and flattened, lateral bridges low, lateral pits shallow; incisive foramina short and narrow; incisors projecting well beyond nasals; dentition slightly more intricate than in *operarius;* m1 has 4 or 5 closed triangles and a rounded terminal loop with a sharp inner salient angle; m3 has 3 closed triangles and 4 inner and 4 outer salient angles.

Measurements.—Type, ♂ ad.: Total length, 155; tail vertebræ, 42; hind foot, 23. Adult ♀ topotype: 190; 45; 22. *Skull:* Basal length, 25.5; nasals, 7; zygomatic breadth, 14.2; mastoid breadth, 11.3; alveolar length of upper molar series, 6. *Skull* (of topotype, ♀ ad.): 30; 8; 17.7; 14; 7.

Remarks.—*Microtus sitkensis* belongs to a well-marked group of the subgenus *Microtus* with the molar pattern of *M. ratticeps* of Europe, although in *sitkensis* m1 is usually closed up, making 5 triangles instead of 4.

Specimens examined.—Total number, 2, from the type locality.

MICROTUS INNUITUS Merriam. Innuit Vole.

Microtus innuitus Merriam, Proc. Wash. Acad. Sci., II, 21, March 14, 1900.

Type locality.—St. Lawrence Island, Bering Sea, Alaska.

Geographic distribution.—Known only from St. Lawrence Island.

General characters.—Size large; tail of medium length, sharply bicolor; skull wide and low, with projecting incisors; dentition mainly as in the *operarius* group.

Cranial characters.—Skull ridged and angular, not much arched; braincase short and wide; nasals short and cuneate, falling considerably back of base of incisors; interparietal small, semicircular; bullæ large, somewhat flattened and angular; pterygoids short; interpterygoid fossa very narrow; dentition heavy, incisors conspicuously projecting; molars with sharply constricted enamel folds; $\overline{\text{m1}}$ with only 4 closed triangles, m3 with three closed triangles, a short posterior loop, and long posterior inner salient angle.

Measurements.—Tail vertebræ, 44; hind foot, 23. *Skull* (of type): Basal length, 32.5; nasals, 9; zygomatic breadth, 19.5; mastoid breadth, 15.3; alveolar length of upper molar series, 7.2.

General remarks.—The specimens from St. Lawrence Island were taken from regurgitated pellets of owls and jaegers, and consist of skulls, feet, tails, and imperfect skeletons. The animals are abundant. Many were seen running in the grass by members of the Harriman party who landed for a short time on the island. The species of *Microtus* coming geographically nearest to St. Lawrence Island is *tshuktshorum* Miller, from Plover Bay, on the Siberian coast, a tiny species bearing little resemblance to the present one.

Specimens examined.—Ten more or less imperfect skulls, besides feet, tails, and parts of skeletons, from the type locality.

MICROTUS ABBREVIATUS Miller. Hall Island Vole.

Microtus abbreviatus Miller, Proc. Biol. Soc. Wash., XIII, 13, Jan. 31, 1899.

Type locality.—Hall Island, Bering Sea, Alaska.

Geographic distribution.—Known only from Hall Island.

General characters.—Size rather large; tail very short, and densely haired; ears concealed in long fur; feet large and stout, measuring about 23.

Color.—July pelage: Upperparts dark buff or yellowish brown, brightest over ears, face, and rump; belly creamy white or pale buff; tail sharply bicolor, a narrow line of dark brownish above, creamy below; feet soiled white. *Young* (half-grown specimens): Duller and darker.

Cranial characters.—Skull similar to that of *unalascensis* in size and general appearance, but more heavily ridged, with deeper prezygomatic notches, larger, more quadrangular interparietal, shallower lateral pits of palate; slightly smaller and especially narrower audital bullæ; rather lighter dentition, with different molar pattern. m1 and m2 with base of posterior triangles broadly open; $\underline{m3}$ shortened, with but 2 closed triangles, 3 outer, and 4 inner salient angles, the third triangle opening into short posterior loop; $\overline{m1}$ with 5 completely closed triangles, and a well developed anterior trefoil, 4 outer, and 5 inner sharp, salient angles back of terminal loop. From the St. Matthew Island subspecies *fisheri*, it differs in molar pattern as from *unalascensis*, and also in slenderer skull and rostrum, slenderer zygomata, and wider interpterygoid fossa.

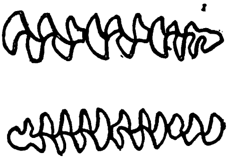

FIG. 5.—Molar enamel pattern of *Microtus abbreviatus* (× 5).

Measurements.—Average of 4 adult topotypes: Total length, 160; tail vertebræ, 25.7; hind foot, 23.3. *Skull* (of No. 97981, ♂ ad.): Basal length, 30.3; nasals, 8.8; zygomatic breadth, 18; mastoid breadth, 14; alveolar length of upper molar series, 7.

General remarks.—*Microtus abbreviatus* was described from an alcoholic specimen retaining none of the original colors. On the Harriman expedition 7 specimens were collected July 14 on Hall Island, and for the first time the natural appearance of the animal was made known. In external characters it strongly resembles a lemming on account of the short tail, long fur, and stout form, but the skull is that of a robust *Microtus*. It belongs to the subgenus *Microtus*, and in general character comes nearest to the *operarius* group, from which it is excluded, however, by its unique molar pattern—$\underline{m3}$ having but 2 closed triangles, while m1 has 5.

Specimens examined.—Total number, 8, from the type locality.

MICROTUS ABBREVIATUS FISHERI Merriam. St. Matthew Island Vole.

Microtus abbreviatus fisheri Merriam, Proc. Wash. Acad. Sci., II, 23, March 14, 1900.

Type locality.—St. Matthew Island, Bering Sea, Alaska.

Geographic distribution.—Known only from St. Matthew Island.

General characters.—Similar to *abbreviatus*, but slightly larger and darker; rostrum longer and heavier; nasals anteriorly expanded and posteriorly notched.

Color.—Summer pelage (July specimens): Upperparts dark rich buff, brightest over ears, face, and rump, sprinkled with black hairs over back; belly strong clear buff; tail buff, with concealed dusky line above; feet pale buffy. *Young* (half-grown specimens): Duller and darker.

Cranial characters.—Skull larger than in *abbreviatus*, with relatively narrower braincase; rostrum longer and heavier on account of the longer, anteriorly spreading nasals; posterior tip of nasals distinctly notched; dentition slightly heavier than in *abbreviatus*, but with essentially the same molar enamel pattern.

Measurements.—Average of 7 adults, 1 male and 6 females, from St. Matthew Island: Total length, 166; tail vertebræ, 27; hind foot, 22.7. One adult ♂ : 178; 32; 24. *Skull* (No. 97976, ♂ ad.): Basal length, 31.3; nasals, 9.8; zygomatic breadth, 19; mastoid breadth, 14; alveolar length of upper molar series, 7.3.

General remarks.—*Microtus a. fisheri* needs comparison only with *abbreviatus*, from which it differs in well-marked subspecific characters. The external differences are less marked than the cranial, as a natural result of the very similar conditions on the neighboring islands occupied by the two forms. Hall Island, the home of *abbreviatus*, is separated from St. Matthew Island, the home of *fisheri*, by about 4 miles of deep sea.

Specimens examined.—Total number, 8, from the type locality.

MICROTUS TOWNSENDI (Bachman). Townsend Vole.

Arvicola townsendi Bachman, Journ. Acad. Nat. Sci. Phila., VIII, 60, Pl. I, 1839.
Arvicola occidentalis Peale, U. S. Expl. Expd., Mammalogy, 45, 1848. (Puget Sound.)

Type locality.—Lower Columbia River, near mouth of Willamette, on or near Wappatoo (or Sauvie) Island.

Geographic distribution.—Low country west of the Cascades, from Port Moody, British Columbia, south to the Willamette Valley and to Yaquina Bay, Oregon, in Transition zone.

Habitat.—Open grass land, pastures, fields, and dry meadows.

General characters.—Size large; fur thin and harsh; ears conspicuous above fur; color dark brownish; a pair of conspicuous glands on hips in adult males.

Color.—*Summer pelage:* Back vandyke brown, much darkened with long black hairs; sides dark buffy gray; belly grayish or dusky; tail blackish, scarcely lighter below; feet plumbeous gray. *Winter pelage* (imperfect in late October and April specimens): Slightly grayer above and lighter below. *Young:* Darker than adult, with dusky belly and blackish feet and tail.

Cranial characters.—Skull long and not much arched; angular and heavily ridged in old age; superciliary ridges conspicuous; incisive foramina long and narrow, constricted posteriorly; lateral pits of palate deep; bullæ medium in size and well rounded; dentition heavy; m2 with four closed sections; m3 with 3 closed triangles, 4 inner and 3 outer salient angles; m1 with 5 closed triangles, 5 inner and 4 outer salient angles. The long, narrow incisive foramina distinguish the skull most readily from that of *californicus*.

Measurements.—Adult male from Oregon City, Oreg.: Total length, 226; tail vertebræ, 66; hind foot, 26. Average of 10 adults, 5 ♂ and 5 ♀, from Avon, Wash.: 193; 64; 25.4. *Skull* (No. 56907, from Oregon City, Oreg.): Basal length, 29.2; nasals, 8.4; zygomatic breadth, 17.1; mastoid breadth, 13.5; alveolar length of upper molar series, 7.5.

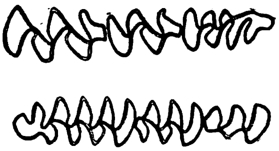

Fig. 6.—Molar enamel pattern of *Microtus townsendi* (× 5).

General remarks.—*Microtus townsendi* has no close affinities with any species except *tetramerus* of Vancouver Island. Except for the conspicuous hip glands, it comes nearest to the *longicaudus* and *mordax* group in combination of general characters. Almost no variation is shown throughout its rather limited range, and there are no characters by which to recognize *occidentalis* even as a subspecies.

Specimens examined.—Total number, 74, from the following localities:

Oregon: Oregon City, 1; Aumsville, 2; Yaquina Bay, 5; Newport, 6; Shelburn, 1 (im); Salem, 1.
Washington: Tenino, 2; Steilacoom, 3; Roy, 2; Kent, 1; Lake Washington, Seattle (south end), 3; Avon, 25; Mount Vernon, 4; Sauk, 1.
British Columbia: Port Moody, 16; Chilliwack, 1.

MICROTUS TETRAMERUS (Rhoads). Vancouver Vole.

Arvicola (*Tetramerodon*) *tetramerus* Rhoads, Proc. Acad. Nat. Sci. Phila., Oct., 1894, 283.

Type locality.—Beacon Hill Park, Victoria, British Columbia.

Geographic distribution.—Southern end of Vancouver Island.

General characters.—Like *townsendi*, but slightly smaller, with slenderer feet and tail and narrower, slenderer skull.

Color.—Indistinguishable from that of *townsendi*, in either winter or summer pelage.

Cranial characters.—Skull smaller, slenderer, and less arched than in *townsendi*, with superciliary ridges never quite meeting; nasals relatively shorter and more spreading anteriorly; incisors slenderer; molars smaller but with the same enamel pattern.

Measurements.—Average of 6 adult males from Goldstream (near Victoria), Vancouver Island: Total length, 177; tail vertebræ, 54.3; hind foot, 22. The largest of a series of 14: 190; 60; 23. *Skull* (No. 91901, ♂ ad.): Basal length, 27.3; nasals, 7.8; zygomatic breadth, 16; mastoid breadth, 12.4; alveolar length of upper molar series, 6.7.

General remarks.—The marked difference in size, together with slight cranial characters, separates this insular form as an easily recognizable species. Specimens of *townsendi* from the nearest localities on the mainland, Port Moody, British Columbia, and Avon, Wash., show no tendency toward *tetramerus*. The small series of specimens includes both summer and winter pelage.

Specimens examined.—Total number, 17, from near the type locality:

Vancouver Island, B. C.: Goldstream, 16; near Victoria, 1.

MICROTUS LONGICAUDUS (Merriam). Long-tailed Vole.

Arvicola (*Mynomes*) *longicaudus* Merriam, Am. Nat., XXII, 934–935, Oct., 1888.

Type locality.—Custer, S. Dak. (in the Black Hills at an altitude of about 5,500 feet).

Geographic distribution.—Boreal cap of the Black Hills and down some of the cold streams well into the Transition zone.

Habitat.—Banks of cold streams and in mountain meadows.

General characters.—Size of body about equal to that of *Microtus pennsylvanicus;* tail much longer; ears larger; colors grayer; skull flatter; braincase wider.

Color.—*Summer pelage:* Upperparts dull bister, darkened with numerous black-tipped hairs, becoming grayish on the sides and shading into dull, buffy gray on belly; feet plumbeous; tail dimly bicolor, blackish above, soiled whitish below. *Winter pelage* (old and faded in a June specimen from Sundance, Wyo.): Upperparts grayish bister, mixed with blackish-tipped hairs, shading gradually into slightly paler sides and dull whitish belly; tail distinctly bicolor; feet soiled whitish.

Cranial characters.—Skull long and not much arched; rostrum long; nasals reaching to anterior plane of incisors; bullæ large and rounded; molar pattern similar to that of *pennsylvanicus*, except for absence of posterior loop in middle upper molar; $\underline{m3}$ with 3 closed triangles, 3 outer and 4 inner salient angles; $\overline{m1}$ with anterior loop, 5 closed triangles, 4 outer and 5 inner salient angles. From *mordax* it differs in slightly shorter, heavier rostrum and wider nasals; narrower interpterygoid fossa; wider expansion of jugal; shorter and wider condyloid ramus of mandible.

Measurements.—Type, ♀ ad.: Total length, 185; tail vertebræ, 65; hind foot, 21. Topotype, ♀ ad.: 184; 61; 22. *Skull* (of type): Basal length, 25; nasals, 7.8; zygomatic breadth, 15.2; mastoid breadth, 11.6; alveolar length of upper molar series, 6.3.

General remarks.—*Microtus longicaudus* stands as one of the few outlying and isolated forms, though the first-described species of its widely distributed group. Its nearest neighbor is *M. mordax* of the Bighorn Mountains, Wyoming, between which range and the Black Hills neither species is known to occur.

Specimens examined.—Total number, 6, from the following localities:

South Dakota: Custer, 2.
Wyoming: Sundance (in the western edge of the Black Hills), 4.

MICROTUS MORDAX (Merriam). Cantankerous Vole.

Arvicola (*Mynomes*) *mordax* Merriam, North American Fauna No. 5, 61, July 30, 1891.

Microtus vellerosus Allen,[1] Bul. Am. Mus. Nat. Hist., XII, 7, March, 1899. (Liard River, Northwest Territory.)

Microtus cautus Allen,[1] Bul. Am. Mus. Nat. Hist., XII, 7, March, 1899. (Hell Gate, Liard River, Northwest Territory.)

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[1] The types of *Microtus vellerosus* and *M. cautus*, kindly loaned me for comparison by Dr. Allen, agree in every character with specimens in corresponding pelage of *M. mordax* from its type locality. The type of *vellerosus*, collected May 4, shows the dark brownish-gray back of imperfect summer pelage, while the type of *cautus*, collected November 29, shows the light gray pelage of early winter.

Type locality.—Sawtooth (or Alturas) Lake, east foot of the Sawtooth Mountains, Idaho.

Geographic distribution.—Rocky Mountains and outlying ranges from latitude 60° to northern New Mexico, and south in the Cascades and Sierra Nevada as far as Kaweah and Kern rivers, California. In the Cascades mainly confined to the east slope, but extending west to the Siskiyous, in southern Oregon, and Salmon and Trinity mountains, in northern California. Found in most of the isolated ranges of eastern Oregon and northern and central Nevada. Common in Canadian and Hudsonian zones.

Habitat.—Marshes and wet woods, but more especially the banks of cold mountain streams, down which it often extends into the Transition zone.

General characters.—Size medium; tail long; ears large; feet small; no conspicuous side or hip glands in males. Very similar to *longicaudus.*

Color.—*Summer pelage:* Back grayish bister; sides olive gray; belly washed with whitish; nose dusky; feet plumbeous; tail dimly bicolor, dusky above, soiled whitish below. *Winter pelage:* Lighter colored than in summer; dorsal stripe of yellowish bister more sharply contrasted with the deeper gray of sides and face; belly heavily washed with pure white; tail sharply bicolor; feet whitish. *Young:* Darker, less sharply marked than the adults; feet and tail dusky.

Cranial characters.—Skull light and slender, similar to that of *longicaudus*, but with slightly longer, slenderer rostrum and nasals; slenderer zygomata, and longer condylar ramus of mandible; dentition essentially the same; $\underline{\text{m2}}$ with 4 closed sections, the posterior open; $\underline{\text{m3}}$ with anterior crescent, 3 closed triangles, and posterior loop with 2 inner salient angles; $\overline{\text{m1}}$ with 5 closed triangles, 5 inner and 4 outer salient angles back of anterior loop; second and third lower molars each with 3 outer and 3 inner salient angles.

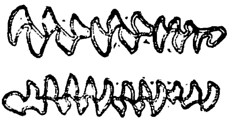

FIG. 7.—Molar enamel pattern of *Microtus mordax* (×5).

Measurements.—Type: Total length, 200; tail vertebræ, 77; hind foot, 22. Average of five adults from type locality, 182; 66; 22. *Skull* (of type): Basal length, 26.5; nasals, 8.6; zygomatic breadth, 16.2; mastoid breadth, 12.8; alveolar length of upper molar series, 6.6.

General remarks.—The species has a wide and frequently interrupted range, but shows remarkably slight variation of characters. Even from the southern extremities of the Rocky Mountains and Sierra Nevada the variation is too slight for subspecific recognition. Specimens from isolated ranges in Nevada are practically typical.

Specimens examined.—Total number, 708, from the following localities:

Idaho: Sawtooth Lake, 35; Lemhi, 4; Lost River Mountains, 2; Salmon River Mountains, 1; Three Creek, 1; Preuss Mountains, 1; Montpelier Creek, 3; Kingston, 1; Osborn, 1; Mullan, 10; Cœur d'Alene, 7; Craig Mountains, 1; Seven Devils Mountains, 3; Priest Lake (east side), 2.

Utah: Laketown, 6; Park City, 1; Barclay, 3; near Barclay, 4.

Colorado: Estes Park, 2; Ward, 4; Gold Hill, 2; Longs Peak, 10; Canyon City, 1; Lake City, 2; Silverton, 5; Fort Garland, 12.

New Mexico: Chama, 1; Martinez, 1; Agua de Lobo, 1 (no skull).

Wyoming: Bridger Pass, 14; Bighorn Mountains, 1; Lake Fork, near Bull Lake, 4; Clark Fork, mouth of Crandle Creek, 3; Tower Falls, Yellowstone Park, 2.

Montana: Red Lodge, 2; Pryor Mountains, 8; Fort Custer, 2; Big Snowy Mountains, 2; Jefferson River, 1; Blackfoot, 1; St. Marys Lake, 3; Java, 4; Summit, 5; Flathead Lake, 8; Tobacco Plains, 2; Horse Plains, 3; Upper Stillwater Lake, 6; Prospect Creek, 11; Thompson Falls, 2; Silver, 4.

Nevada: Reese River, 18; Arc Dome, 15; Indian Creek, 1; Shoshone Mountains, north of Cloverdale, 5; Pine Forest Range, 3; Granite Creek, 8; Mountain City, 15; Bull Run Mountains, 1; White Mountains, 6; Ruby Mountains, 14; Monitor Mountains, 2.

California: Near Mount Whitney, 31; Olancha Peak, 1; Mulkey Meadows (near Olancha Peak), 1; Soda Springs (on North Fork of Kern River), 1; Mineral King (on East Fork Kaweah River), 19; Upper San Joaquin River, 2; Lone Pine, 2; Bishop Creek, 2; Queen Station, 1; Sequoia National Park, 24; Yosemite Valley, 3; Pine City, 1; Mammoth, 7; White Mountains, 4; Donner, 3; Sierra Valley, 3; Hope Valley, 2; Carberry Ranch, 10; Emerald Bay, 5; Goose Lake, 2; Warner Creek, 1; Lassen Creek, 2; Lassen Peak, 19; Etna, 1; Trinity Mountains, 4; Canyon Creek, 16; Plumas County (20 miles southwest of Quincy), 2; Mount Shasta, 59; Sisson, 15; Goose Nest Mountain, 1; Bear Creek (Shasta County), 1.

Oregon: Siskiyou, 6; Fort Klamath, 18; Crater Lake, 5; Diamond Lake, 5; Sink Creek (east of Mount Thielson), 1; Upper Des Chutes River, Little Meadows (near head of Des Chutes River), 2; Farewell Bend (Des Chutes River, 30 miles southwest Prineville), 2; Swan Lake Valley, 2; head of Drews Creek, 1; Warner Mountains, 3; Steen Mountains, 6; Summit (east of Malheur Lake), 1; 10 miles north of Harney, 9; Maury Mountains, 5; Wallowa Mountains, 3; Lone Rock, 1.

Washington: Cleveland, 2; Wenatchee, 5; head of Lake Chelan, 12; Easton, 2; Conconully, 3.

British Columbia: Mount Richter, 2; Nelson, 1; Sicamous, 5; Hope, 2; Shuswap, 1; Glacier, 3; Okanagan, 2; Bennett City, 6.

Alberta: Henry House, 19; 15 miles south of Henry House, 4; south of Smoky River, 3; Banff, 1.

Northwest Territory: Liard River, 2; Rink Rapids (upper Yukon), 1; Lake Lebarge, 2; Lake Marsh, 1.

Alaska: Charlie Creek (Upper Yukon), 4; Circle, 1; White Pass, 5; Skagway, 1.

MICROTUS MACRURUS Merriam. Olympic Vole.

Microtus macrurus Merriam, Proc. Acad. Nat. Sci. Phila., Aug., 1898, 353.

Type locality.—Lake Cushman, Olympic Mountains, Washington.

Geographic distribution.—(The typical form) Olympic Mountains. (With slight variation) along the coast strip of British Columbia and Alaska north to Yakutat.

Habitat.—Marshes and borders of cold streams.

General characters.—Like *mordax*, but considerably larger, with conspicuously larger hind foot and darker coloration.

Color.—*Summer pelage:* Upperparts dark bister, shaded with numerous black hairs, becoming sooty gray in some specimens; sides slightly paler; belly washed with dull buffy or whitish; feet plumbeous; tail distinctly bicolor, blackish or brownish above, soiled whitish below, usually white-tipped. (*Winter pelage* unknown.) *Young:* Darker than adult, with blackish feet and tail.

Cranial characters.—Skull averaging much larger than *mordax*, with wider interorbital region, heavier rostrum, smaller audital bullæ, and heavier dentition; molars especially wider; lower jaw conspicuously more massive, with wide, heavy molars.

Measurements.—Type: Total length, 220; tail vertebræ, 88; hind foot, 24. Average of five specimens from three localities in the Olympic Mountains: 204; 80; 24.3. *Skull* (of type, No. 66151, ♂ ad.): Basal length, 27.7; nasals, 8.2; zygomatic breadth, 16; mastoid breadth, 12.5; alveolar length of upper molar series, 7.

General remarks.—*Microtus macrurus* is the most conspicuously marked and easily recognizable form of the *longicaudus* group, though with less deeply seated characters than some forms that are externally scarcely distinguishable from each other. In the Olympic Mountains its range is completely isolated, being separated from that of *mordax* by the intervening low country, the habitat of the larger *townsendi*, and by the high Cascades, in which neither form occurs. To the northward it again occurs, in nearly typical form, on the coast at Lund, British Columbia (lat. 50°), and extends northward along the coast to Yakutat, Alaska, becoming slightly smaller and less markedly different from true *mordax.*

Specimens examined.—Total number, 84, from the following localities:

Washington: Lake Cushman, 7; head of Skokomish River, 1; head of Soleduc River, 1; Quinoault Lake, 4; Granville, 1.

British Columbia: Lund, on Malaspina Inlet, 3; River Inlet (head), 14; Fort Simpson, 6.

Alaska: Loring, 3; Wrangell, 4; Juneau, 12; Yakutat, 7; Yakutat Bay (north shore), 10; Glacier Bay, 11.

MICROTUS ANGUSTICEPS Bailey. Coast Vole.

Microtus angusticeps Bailey, Proc. Biol. Soc. Wash., XII, 86, April 30, 1899.

Type locality.—Crescent City, California.

Geographic distribution.—Coast region of northwestern California and southwestern Oregon.

Habitat.—Damp pastures in the Sitka spruce belt.

General characters.—Smaller and darker colored than typical *mordax*, with very narrow, slender skull and small audital bullæ.

Color.—*Summer pelage:* Upperparts dark bister, lined with black hairs, darkest on face and nose; sides paler; belly washed with creamy white; feet plumbeous gray; tail distinctly bicolor, blackish above, soiled white below.

Cranial characters.—Skull small and very narrow, distinctly ridged in adults; nasals projecting in front of incisors; incisive foramina short; audital bullæ very small and constricted; coronoid notch of mandible narrow; incisors slender; molars small, with narrow, sharp angles; enamel pattern as in *mordax*.

Measurements.—Type, ♂ ad.: Total length, 170; tail vertebræ, 56; hind foot, 22. An adult ♀ topotype: 170; 55; 22. *Skull* (of type): Basal length, 23.4; nasals, 7.6; zygomatic breadth, 13.5; mastoid breadth, 10.8; alveolar length of upper molar series, 6.

General remarks.—Externally this species is not very different from true *mordax*, but the skull shows such marked characters as to warrant full specific rank.

Specimens examined.—Total number, 45, from the following localities:

California: Crescent City, 31; Arcata (Humboldt Bay), 13.
Oregon: Gold Beach, 1.

MICROTUS ALTICOLUS (Merriam). Mountain Vole.

Arvicola (*Mynomes*) *alticolus* Merriam, North American Fauna No. 3, 67–69, Pl. V, figs. 1 and 2; Pl. VI, figs. 1, 2, 3, and 4; Sept. 11, 1890.

Type locality.—San Francisco Mountain, Arizona (Little Spring, on northwest side of mountain, altitude 8,200 feet).

Geographic range.—Boreal zone of San Francisco Mountain, from 8,200 feet altitude up to timberline at 11,000 feet.

Habitat.—Vicinity of springs and cold streams on the slopes of the mountain.

General characters.—Similar to *longicaudus*, but tail shorter, hind foot and ear smaller, and skull with truncate, instead of pointed, anterior end of frontal and deeper lateral pit of palate.

Color.—*Summer pelage:* Upperparts uniform sepia or dull bister. darkened with blackish-tipped hairs; sides scarcely lighter; belly pale buffy or whitish; feet dull grayish or dirty whitish; tail not sharply bicolor, blackish above, grayish below. *Young:* Similar to adults, but with woolly fur and long, scattered, black-tipped hairs. (*Winter pelage* unknown.)

Cranial characters.—Skull similar to that of *mordax*, but readily distinguished from it and those of all other forms of the group by truncate end of anterior arm of frontal. Other characters are, deeper lateral pits of the palate; wider interpterygoid fossa; slightly longer, more open, incisive foramina. Dentition similar to that of *longicaudus* and *mordax*.

Measurements.—Type, ♀ ad.: Total length, 170; tail vertebræ, 56; hind foot, 20. Average of 5 adults from type locality: 178; 56; 20. *Skull:* Basal length, 25; nasals, 7.5; zygomatic breadth, 14.8; mastoid breadth, 12.3; alveolar length of upper molar series, 6.5.

General remarks.—*Microtus alticolus*, with its subspecies *leucophæus*, is the most isolated form in the *longicaudus* group. Its geographically nearest neighbor and probably nearest relative is *mordax*, in the mountains of Colorado and northern New Mexico.

Specimens examined.—Total number, 13, from the type locality. One immature specimen from Springerville, in the White Mountains, may be either *alticolus* or *leucophæus*.

MICROTUS ALTICOLUS LEUCOPHÆUS (Allen). Graham Mountain Vole.

Arvicola leucophæus Allen, Bul. Am. Mus. Nat. Hist., VI, 320–321, Nov. 7, 1894.

Type locality.—Graham Mountains, Arizona.

Geographic distribution.—Known only from the type locality.

General characters.—Similar to *alticolus*, and of the same proportions, but slightly larger, color the same, skull wider interorbitally and with other slight differences.

Color.—*Summer pelage:* Upperparts sepia or dull bister, but little paler on sides and faintly lined with blackish hairs; belly washed with soiled whitish; feet dull grayish; tail distinctly bicolor, brown above, grayish below. (*Young* and *winter pelages* not represented.)

Cranial characters.—Skull wider interorbitally than in *mordax* or *alticolus;* anterior arm of frontal with triangular instead of truncate point; incisive foramina wider than in *alticolus*, slightly constricted posteriorly; lateral pits of palate wide and shallow; coronoid notch narrow and sharp. Dentition as in *alticolus* and *mordax.*

Measurements.—Type, ♀ ad.: Total length, 173; tail vertebræ, 50; hind foot, 22.5. Topotype, ♀ ad.: 183; 50; 23. *Skull* (of type): Basal length, 26.5; nasals, 8.3; zygomatic breadth, 15.2; mastoid breadth, 12.3; interorbital width, 4.2; alveolar length of upper molar series, 6.3.

General remarks.—*Microtus leucophæus* belongs to the *longicaudus* group. It is closely related to *alticolus*, from which size and slight cranial characters separate it as a fairly well-marked subspecies.

Through the kindness of Dr. J. A. Allen, of the American Museum of Natural History, I have the type and a topotype of *M. leucophæus* for comparison with the Biological Survey series of *alticolus*, *mordax*, and *longicaudus.*

Specimens examined.—Total number, 2, from the type locality.

MICROTUS MEXICANUS (De Saussure). Mexican Vole.

Arvicola (*Hemiotomys*) *mexicanus* De Saussure, Revue et Mag. de Zool., 2e sér., XIII, 3, Jan., 1861.

Type locality.—Mount Orizaba, Puebla, Mexico.

Geographic distribution.—Eastern Puebla and to the north and west, grading into its subspecies *phæus.*

Habitat.—Grassy places in open forests, in upper Austral and Transition zones.

General characters.—Size rather small; tail short; ears conspicuous; pelage coarse and lax; colors brownish; skull wide, with short, wide incisive foramina; m1 normally with 6 inner salient angles.

Color.—*Winter pelage:* Upperparts grizzled brown, from a mixture of dull cinnamon and black; sides paler; belly washed with cinnamon or buffy, or rarely with whitish; sides of nose and ear coverts usually a brighter shade of cinnamon; feet clear gray; tail dusky above, gray below. *Summer pelage* (imperfectly represented): Evidently darker and less ferruginous. *Young:* Duller and darker than adult.

Cranial characters.—Skull rather angular, with wide-spreading zygomatic arches, narrow interorbital constriction, and large, well-rounded audital bullæ; incisive foramina short and wide, truncate posteriorly; zygomata broadly flattened; palate with a median groove between the lateral pits where a spur or ridge appears in most species of *Microtus;* upper incisors abruptly decurved; molar pattern differing from that of *nanus* and *montanus*—mainly in extra angle of anterior trefoil of m1; most of the salient angles acute; m2 has 4 closed sections; m3 has 3 closed triangles, 3 outer and 4 inner salient angles; m1 has 5 closed triangles, 5 outer and 6 inner salient angles.[1]

Measurements.—Average of 10 adults from the type locality (5 ♂ 5 ♀): Total length, 138; tail vertebræ, 29; hind foot, 19.35; maximum: 148; 30; 20. *Skull* (of topotype, No. 54496, ♂ ad.): Basal length, 24.5; nasals, 7.4; zygomatic breadth, 15.3; mastoid breadth, 11.6; alveolar length of upper molar series, 6.6.

General remarks.—*Microtus mexicanus*, *phæus*, *fulviventer*, and *mogollonensis* form a well-marked and closely united group of small, short-tailed, brownish voles, distinguished by the arrangement of mammæ in two pairs, a pair of inguinal, and a pair of pectoral; by wide-spreading zygomatic arches and narrow interorbital constriction; by wide incisive foramina and grooved posterior ridge of palate; and by similar habits and habitat. They need comparison only among themselves. While *mogollonensis* and *fulviventer* are well-marked forms, occupying widely separated and probably disconnected areas, *mexicanus* and *phæus* merely show the extremes of differentiation found in one wide-ranging and somewhat variable form. As only those from the type localities are really typical, any line separating *mexicanus* and *phæus* is purely arbitrary.

Specimens examined.—Total number, 194, from the following localities in Mexico:

Puebla: Mount Orizaba, 27; Chalchicomula, 22.
Vera Cruz: Cofre de Perote, 29; Las Vegas, 11.
Tlaxcala: Mount Malinche, 1; Huamantla, 2.
Hidalgo: Sierra de Pachuca, 7; Tulancingo, 7; Real del Monte, 10.
Morelos: Huitzilac, 4.
Mexico: Ajusco, 6; Toluca Valley, 20; North slope Volcan de Toluca, 9; Mount Popocatepetl, 19; Amecameca, 1; Salazar, 19.

MICROTUS MEXICANUS PHÆUS (Merriam). Colima Vole.

Microtus phæus Merriam, Proc. Biol. Soc. Wash., VII, 171–172, Sept. 29, 1892.

Type locality.—North slope of Sierra Nevada de Colima, Jalisco, Mexico (altitude 10,000 feet).

Geographic distribution.—Southern Jalisco and northward to northwestern Chihuahua (to the eastward, grading into *mexicanus*), occupying Boreal and Transition zones.

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[1] This extra number of angles is a weak character depending on the slightly unusual development of the anterior trefoil of m1, so that a pair of short points or angles may in most cases be counted on its inner and outer sides.

Habitat.—Grassy parks in open timber.

General characters.—Similar to *mexicanus*, but slightly larger and a shade darker, and with slight cranial differences.

Color.—*Winter pelage:* Upperparts uniform dark cinnamon brown mixed with blackish; belly a lighter shade of cinnamon or buffy, or sometimes whitish; feet brownish gray; tail brownish gray, paler below. *Summer pelage:* Not shown in specimens from near the type locality, but June specimens from El Salto, Durango, are brighter and darker ferruginous than topotypes in winter pelage. *Young:* Dull brownish.

Cranial characters.—Skull similar to that of *mexicanus*, but with less constricted interorbital region, slightly shorter incisive foramina, and shallower prezygomatic notches. Dentition essentially the same.

Measurements.—Average of 10 adult topotypes (5 ♂ and 5 ♀): Total length, 151; tail vertebræ, 35; hind foot, 20.5. *Skull* (topotype, ♂ ad., No. 45645): Basal length, 25.2; nasals, 7.3; zygomatic breadth, 15.5; mastoid breadth, 12; alveolar length of upper molar series, 6.08.

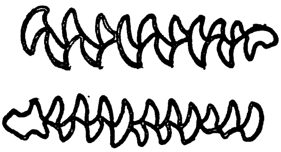

FIG. 8.—Molar enamel pattern of *Microtus phæus* (× 5).

General remarks.—*Microtus m. phæus* is not a strongly or sharply marked form of *mexicanus*, although apparently the more widespread form. Ajusco and Salazar specimens might as well be referred to it as to *mexicanus*. A large series from near Guadalupe, in southwestern Chihuahua, are indistinguishable from typical *phæus*, and those from Miquihuana, western Tamaulipas, are nearer to *phæus* than to *mexicanus*.

Specimens examined.—Total number, 136, from the following localities in Mexico:

Jalisco: Sierra Nevada de Colima, 17.
Michoacan: Nahuatzin, 23.
Queretaro: Pinal de Amoles, 9.
Tamaulipas: Miquihuana, 20.
Durango: El Salto, 25.
Chihuahua: Sierra Madre near Guadalupe y Calvo, 19; Colonia Garcia, 23.

MICROTUS FULVIVENTER Merriam. Oaxaca Vole.

Microtus fulviventer Merriam, Proc. Biol. Soc. Wash., XII, 106, April 30, 1898.

Type locality.—Cerro San Felipe, Oaxaca, Mexico.

Geographic distribution.—Central part of the State of Oaxaca.

Habitat.—Open grassy places and along edges of fields in the Boreal zone.

General characters.—Slightly larger than *mexicanus* and of nearly the same proportions; darker and richer in coloration; ears conspicuous above fur; tail a little more than one and a half times the length of hind foot.

Color.—*Summer pelage:* Upperparts umber brown, darkened by black hairs; under parts fulvous or dull chestnut brown; feet grayish brown;

tail dusky brown above, fulvous below, darker toward the end. *Winter pelage* (in October and March specimens): Less deeply colored. *Young:* Dull sooty, with scarcely a trace of fulvous.

Cranial characters.—Skull similar to that of *mexicanus*, but with smaller bullæ, longer incisive foramina; sharper posterior point of frontals; molars slightly heavier, enamel pattern almost the same: $\overline{m1}$ has a more rounded anterior loop.

Measurements.—Average of 10 adult topotypes (5 ♂ and 5 ♀): Total length, 152; tail vertebræ, 35; hind foot, 20.5. Type (♂ ad.): 154; 38; 20. *Skull* (of type): Basal length, 25.4; nasals, 7.4; zygomatic breadth, 15.5; mastoid breadth, 12.4; alveolar length of upper molar series, 6.5.

General remarks.—*M. fulviventer* belongs to the *mexicanus* group, but is sharply separated in its distinguishing characters as well as in geographic range. But little variation is shown throughout its range and although specimens from the mountains near Ozolotepec show differences, these are slight and unimportant.

Specimens examined.—Total number, 126, from the following localities in Mexico:

Oaxaca: Cerro San Felipe, 32; Reyes, 23; 15 miles west of Oaxaca, 20; Mount Zempoaltepec, 28; near Cajones, 5; Guajamaloya, 1 (im.); mountains near Ozolotepec, 9; Totontepec, 8.

MICROTUS MOGOLLONENSIS (Mearns). Mogollon Mountain Vole.

Arvicola mogollonensis Mearns, Bul. Am. Mus. Nat. Hist., II, No. 4, 283–284, Feb., 1890.

Type locality.—Baker Buttes, Mogollon Mountains, Arizona.

Geographic distribution.—Plateau country of central Arizona.

Habitat.—Dry grassy parks among the yellow pines of the Transition zone.

General characters.—Size small; tail and feet short; color dull rusty brown; fur long and soft; ears not concealed; skull short, wide, and angular; lateral pits of palate very deep; an inner projecting point at base of posterior triangle of middle upper molar.

Color.—Upperparts dull rusty brown, brightest on tips of ears; sides slightly paler; belly cinnamon or buffy gray; feet grayish brown; tail brownish gray above, grayish below.

Cranial characters.—Skull short and well arched, with wide-spreading zygomata and sharply constricted interorbital region; zygomatic shield broad and flat; interparietal small and narrow; nasals notched posteriorly, falling considerably short of terminus of premaxillæ; bullæ full and rounded; incisive foramina short, wide, and open; incisors wider than in *nanus* and bent more abruptly downward; molar pattern as in *mexicanus*, except in $\underline{m2}$, which has an inner point at base of posterior triangle, and in $\overline{m1}$, which has 5 closed triangles and only 5 inner and 4 outer salient angles and an abbreviated terminal loop.

Measurements.—Average of 10 adults from San Francisco Mountain, Arizona: Total length, 131; tail vertebræ, 28.5; hind foot, 18. *Skull* (adult ♂, No. 24563): Basal length, 23.6; nasals, 7; zygomatic breadth, 15.2; mastoid breadth, 12; alveolar length of upper molar series, 6.3.

Remarks.—*M. mogollonensis* is widely separated, both geographically and specifically, from the other members of its group. Its nearest ally is *phæus* from Mexico.

Specimens examined.—Total number, 51; from the following localities:

Arizona: San Francisco Mountain (Little Spring on north side of mountain), 15; Springerville, 35.

New Mexico: Fort Wingate, 1.

MICROTUS XANTHOGNATHUS (Leach). Yellow-cheeked Vole.

Arvicola xanthognatha Leach, Zool. Miscel., I, 60, 1814.

Type locality.—Hudson Bay.

Geographic distribution.—Northwestern Canada and Alaska, from central Alberta north to the Arctic coast and west to central Alaska.

General characters.—Size large, almost equaling that of *richardsoni*, but tail shorter and ears larger; colors dull; nose and ear patch yellow; skull heavy, ridged, and angular. Side glands as in *richardsoni*, or a little farther back on flanks.

Color (March and May specimens).—Upperparts dark sepia to bister, heavily lined with coarse black hairs over the back; sides of nose and ear patch bright rusty yellowish, a tinge of the same around eyes and on cheeks; belly dusky gray; breast sooty; tail indistinctly bicolor, blackish above, dusky gray below; feet sooty.

Cranial characters.—Skull smaller than that of *richardsoni* and relatively longer and narrower, with less projecting incisors; nasals long and narrow; bullæ large; incisive foramina long and narrow; dentition heavy; molar pattern scarcely different from that of *townsendi;* anterior loop of $\overline{\text{m.1}}$ small and triangular; middle section of $\overline{\text{m.3}}$ frequently divided into two nearly closed triangles.

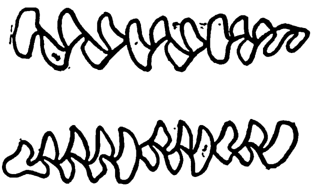

FIG. 9.—Molar enamel pattern of *Microtus xanthognathus* (× 5).

Measurements.—Two dry skins from Fort Resolution, Great Slave Lake, Canada, adult females, in U. S. Nat. Mus. No. 4504: Total length, 210; tail vertebræ, 50; hind foot, 27. No. 4502: 218; 45; 25. *Skull* (No. 4504): Basal length (approximately), 34.5; nasals, 10.3; zygomatic breadth, 20; mastoid breadth, 15.7; alveolar length of upper molar series, 8.5.

Remarks.—*Microtus xanthognathus* shows no close relationship to any other American species. In the position of side glands it resembles *richardsoni*, but in no other characters. It shows a strong superficial resemblance to *chrotorrhinus* in color, but the great difference in size prevents the possibility of one ever being mistaken for the other.

Specimens examined.—Total number, 44, from the following localities:

Canada: Nelson River, N. W. T., 1; Cache Apocotte (40 miles east of Henry House, Alberta), 1; Fort Resolution, 22; Great Slave Lake, 1; Fort Rae, 1; Liard River, 1; La Pierre House, 1; Anderson River, 1; Arctic coast (east of Fort Anderson), 2.

Alaska: Mouth of Porcupine River, 1; Yukon (200 miles southwest of mouth of Porcupine), 3; Charlie Creek (Upper Yukon), 9.

MICROTUS CHROTORRHINUS (Miller). Rock Vole.

Arvicola chrotorrhinus Miller, Proc. Boston Soc. Nat. Hist., XXVI, 189–193, pl. 3, 1894.

Type locality.—Mount Washington, New Hampshire, head of Tuckerman Ravine (altitude, 5,300 feet).

Geographic distribution.—Mount Washington, the Catskills, central Quebec, and northern New Brunswick, in the Hudsonian zone.

Habitat.—Rocky places near water on the mountains, and in deep spruce forests farther north.

General characters.—Size and proportions of *pennsylvanicus* except slightly smaller hind foot; ears larger; fur lax; conspicuously yellowish about nose, ears and rump; skull comparatively thin-walled and smooth; dentition unique.

Color.—*Summer pelage* (July 14): Upperparts bright glossy bister, lined with black hairs; nose to eyes dull orange rufus; hairs around ears and on rump yellowish; belly plumbeous; feet dark gray; tail grayish brown, slightly paler below. Worn, left-over *winter pelage:* Darker and more rusty above.

Cranial characters.—Skull light and smooth, somewhat flattened on top, superficially resembling that of *Evotomys;* bullæ large and rounded; incisive foramina short and wide; dentition rather light; incisors bent down at right angles to axis of skull, extending scarcely beyond tip of nasals; m2 with 4 closed sections; m3 normally with 5 closed triangles, 5 inner and 5 outer salient angles and a double-lobed posterior loop; $\overline{m3}$ with outer salient angles prominent and reentrant angles deep.

Measurements.—Type: Total length, 165; tail vertebræ, 45; hind foot, 19.4. Average of 4 adult topotypes: 170; 48; 19.6. *Skull* (of ad. ♂, No. 2523, Bangs Coll.): Basal length, 25.4; nasals, 7.2; zygomatic breadth, 15; mastoid breadth, 12; alveolar length of upper molar series, 6.4.

Remarks.—*Microtus chrotorrhinus* shows a marked superficial resemblance to *M. xanthognathus*, but in cranial characters it differs widely from this and all other American species and is quite unique in the subgenus *Microtus.* In the specimens examined there is no trace of hip glands, but in two adult males (3845 and 3849) there appear to be rudiments of side glands on the flanks.

Specimens examined.[1]—Total number, 8, from the following localities:[2]

New Hampshire: Mount Washington, 3.
New York: Catskill Mountains, 1.
Quebec: Lake Edward, 4.

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[1] Type in collection of G. S. Miller, jr.; other specimens in the collection of E. A. and O. Bangs.

[2] Mr. Miller records a specimen in the Am. Mus. Nat. Hist. from Trousers Lake, New Brunswick—Proc. Bost. Soc. Nat. Hist., XXVI, 193, 1894.

MICROTUS CHROTORRHINUS RAVUS Bangs. Gray Rock Vole.

Microtus chrotorrhinus ravus Bangs, Proc. Biol. Soc. Wash., XII, 187, Nov. 16, 1898.

Type locality.—Black Bay (north shore of Strait of Belle Isle), Labrador.

Geographic distribution.—Known only from the type locality.

General characters.—Similar to *chrotorrhinus*, but slightly grayer, and with noticeably more yellowish on nose and face. Skull slenderer, with lighter dentition.

Color.—*Summer pelage* (July specimens): Upperparts grayish bister, becoming yellowish on rump; whole face from behind ears suffused with yellowish, brighter on nose; belly thinly washed with white over the plumbeous; feet buffy gray; tail brownish above, slightly paler below.

Cranial characters.—*Skull*, compared with that of *chrotorrhinus*, slightly thinner, lighter, and slenderer throughout; interorbital constriction narrower; rostrum longer and narrower; incisive foramina longer; molar series shorter and narrower; tooth pattern as in *chrotorrhinus*.

Measurements.—Type,[1] ♂ ad.: Total length, 170; tail vertebræ, 50; hind foot, 22. Average of 4 adult topotypes: 159; 46; 21.25. *Skull* (No. 7952, ♀ ad.): Basal length, 25; nasals, 7; zygomatic breadth, 14.3; mastoid breadth, 11.3; alveolar length of upper molar séries, 6.2.

General remarks.—July specimens from the type locality are in full, long pelage, with a freshness of appearance and brightness of color quite different from the type of *chrotorrhinus* of nearly the same date. There is a question as to whether the real summer pelage is shown.

Specimens examined.—Total number, 5, from the type locality.

Subgenus ARVICOLA[2] Lacépède.

Arvicola Lacépède, Nouv. Tableau Méthod. Mamm., in Mém. de l'Instit., Paris, III, 495, 1801. Type, *Mus terrestris* Linnæus (genus).
Arvicola Lataste, Le Naturaliste, II, 349, 1883 (subgenus).

Geographic distribution.—(In America) Boreal zone of the Cascades and Rocky Mountains of Canada and the northern United States.

Subgeneric characters.—(In American species) plantar tubercles, 5; side glands on flanks of males conspicuous; a musk-bearing anal gland; mammæ, 8; pectoral, 2–2; inguinal, 2–2; feet large; tail long; fur full and long; bullæ very small; incisors projecting far beyond premaxillæ; molars with constricted and tightly closed sections; m2 with 4 closed sections; m3 with 3 closed triangles; m1 with 5 closed

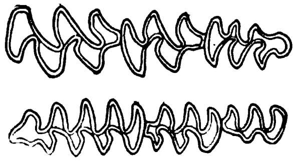
FIG. 10.—Molar enamel pattern of *Microtus* (*Arvicola*) *macropus* (× 5).

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[1] The measurements of type and 4 topotypes are from original description. In 3 adult topotypes the hind foot measures uniformly 20 mm. in dry skins with toes straight.

[2] For full synonymy of the subgenus *Arvicola*, see Miller, N. Am. Fauna No. 12, 66, 1896.

triangles, 5 inner and 4 outer salient angles; $\overline{\mathrm{m3}}$ with 3 transverse loops. (In the European section of the subgenus $\underline{\mathrm{m3}}$ has but 2 closed triangles, and m1 but 3.)

MICROTUS RICHARDSOŇI (De Kay). Richardson Vole.

Arvicola richardsoni De Kay, Zoology of New York, Mammalia, 91, 1842.

Type locality.—"Near the foot of the Rocky Mountains." (Type collected by Drummond in the vicinity of Jasper House, Alberta.)

Geographic distribution.—The typical form is known only from the vicinity of Jasper House and Henry House, Alberta, Canada. To the south it apparently grades into *macropus* in the Rocky Mountains, and *arvicoloides* in the Cascades.

General characters.—Size very large (probably not exceeded in America except by *alleni*); tail long; feet large; fur long and heavy; ears mostly concealed; colors dull; skull large and angular, with protruding incisors.

Color.—*Early winter pelage* (October 14 to 18): Upperparts uniformly grayish sepia, darkened by black-tipped hairs, becoming paler on the sides; belly washed with white over the plumbeous under-fur; feet silvery gray; tail bicolor, dusky above, soiled whitish below.

Cranial characters.—Skull large, with wide-spreading zygomatic arches, long rostrum, very long and protruding incisors; nasals rather short and wide, rounded at both ends, not reaching to base of incisors; audital bullæ small for a *Microtus*, but slightly larger and more rounded than in either of the subspecies; incisive foramina longer and less constricted posteriorly; superoccipital smooth without median ridge; terminal loop of third upper molar normally not recurved.

Measurements.—Young adult, No. 81381, from 25 miles west of Henry House: Total length, 208; tail vertebræ, 61; hind foot, 28. *Skull* (of same): Basal length, 32.5 (over incisors); nasals, 8.3; zygomatic breadth, 19.9; mastoid breadth, 14.6; alveolar length of upper molar series, 7.5.

General remarks.—Richardson's specimens, which he referred to *Arvicola riparius*, and which were later re-described by De Kay, were collected by Thomas Drummond in the foothills of the Rocky Mountains, probably west of Jasper House. In October, 1896, J. Alden Loring collected a series of 8 specimens at points 15 and 25 miles west of Henry House (40 or 50 miles southwest of Jasper House), Alberta, on the very trail by which Drummond crossed from Jasper House to the Columbia in 1826. Unfortunately, none of this series are fully adult, and but one condition of pelage is shown. By comparing specimens of the same age it becomes evident that the species equals the larger of its two southern forms, *arvicoloides*, though in color it agrees more nearly with the Rocky Mountain form, *macropus*. A single specimen from Glacier, British Columbia, is fairly intermediate between *richardsoni* and its two southern subspecies.

Specimens examined.—Total number, 8, from west of Henry House, Alberta, Canada.

MICROTUS RICHARDSONI MACROPUS (Merriam). Big-footed Vole.

Arvicola macropus Merriam, North American Fauna No. 5, 59–60, 1891.

Type locality.—Pahsimeroi Mountains, Idaho (altitude about 9,700 feet).

Geographic distribution.—Boreal zone of the Rocky Mountains from the Wasatch north to Canada, of the Wind River Mountains of Wyoming, the Blue Mountains of Oregon, and most of the intermediate ranges.

General characters.—Similar to *richardsoni*, but evidently somewhat smaller; colors the same in October specimens; distinguished by less projecting incisors and other cranial characters.

Color.—*Summer pelage:* Upperparts dark sepia, lined with long, black hairs; slightly paler on sides; belly washed with silvery white; feet dusky gray; tail distinctly bicolor throughout its length, sooty above, whitish below. *Winter pelage* (imperfect in October and May specimens): Lighter, clearer gray above, black hairs less conspicuous, more heavily washed with white below. *Young:* Like adult or slightly darker, with long, woolly fur and dusky feet and tail; during one stage of pelage with entirely dusky belly.

Cranial characters.—Skull similar to that of *richardsoni*, from which it differs in less projecting upper incisors, longer nasals with narrower posterior tips; supraoccipital with a median ridge; bullæ smaller, more compressed and angular; incisive foramina sharply constricted posteriorly; third upper molar with terminal loop recurved in about half of the specimens.

Measurements.—Type, ♀ ad.: Total length, 220; tail vertebræ, 71; hind foot, 26. Male from type locality (not fully adult): 202; 68; 28. *Skull* (of type): Basal length, 31.5; nasals, 9; zygomatic breadth, 19.7; mastoid breadth, 14.5; alveolar length of upper molar series, 7.5.

General remarks.—In a large series of specimens from numerous ranges of the Rocky Mountains the subspecies remains rather uniform. There is a slight increase in size toward the north, specimens from northern Montana averaging larger than from the type locality. Those from Strawberry Butte and the Wallowa Mountains of eastern Oregon are indistinguishable from the type series. Two half-grown specimens from the top of the Wasatch Mountains, near Park City, Utah, are too young to indicate reliable specific variation.

Specimens examined.—Total number, 113, from the following localities:

Idaho: Pahsimeroi Mountains, 8; Salmon River Mountains, 11; Sawtooth (or Alturas) Lake, 18; head of Wood River, 2; Summit, Alturas County, 1; Seven Devils Mountains, 2; head of Crow Creek, Preuss Mountains, 4; Thompson Pass, 3; Priest Lake, 1.

Utah: Park City, 2.

Wyoming: La Barge Creek, 5; South Pass City, 1; Lake Fork, Wind River Mountains, 10.

Montana: Beartooth Mountains, 17; Summit, Teton County, 2; St. Marys Lake, Teton County, 4.

Oregon: Strawberry Butte, 2; Wallowa Mountains, 20.

MICROTUS RICHARDSONI ARVICOLOIDES (Rhoads). Cascade Water-Vole.

Aulacomys arvicoloides Rhoads, Am. Nat., XXVIII, 182–185, Feb. 11, 1894.
Microtus principalis Rhoads, Am. Nat., XXIX, 940, Oct., 1895. (Mount Baker Range, British Columbia.)

Type locality.—Lake Keechelus, near Snoqualmie Pass, Kittitas County, Washington (altitude 8,000 feet).

Geographic distribution.—Boreal zone of the Cascade Mountains, in Washington and Oregon.

General characters.—Apparently equal to *richardsoni* in size, larger than *macropus*, and slightly darker than either. In cranial characters nearer *macropus* than *richardsoni*.

Color.—*Summer pelage:* Upperparts dark sepia, considerably darkened with coarse black hairs; belly thinly washed with pearl gray or silvery whitish; feet dusky gray; tail bicolor, blackish above, soiled whitish below. *Winter pelage:* Darker than summer, with an excess of black hairs above; belly strongly washed with white; feet and tail as in summer. *Young* not different from young *macropus*.

Cranial characters.—Skull like that of *macropus*, but larger; rostrum and incisors slightly heavier; nasals more broadly spreading anteriorly, with a slight constriction near the middle, narrow, and pointed posteriorly; audital bullæ, incisive foramina, and arc of upper incisors as in *macropus*.

Measurements.—Average of 6 adults, 3 males and 3 females, from Easton, Wash. (near the type locality): Total length, 234; tail vertebræ, 81; hind foot, 29.3. Largest specimen of the series: 253; 89; 29. *Skull* (No. 41578, ♂ ad., from Easton): Basal length, 36; nasals, 10.8; zygomatic breadth, 23; mastoid breadth, 16.3; alveolar length of upper molar series, 8.3.

General remarks.—I have before me a series of 13 specimens, collected at Easton, on the outlet of Lake Keechelus, about 12 miles from the type locality, and a large number of specimens from the upper slopes of Mount Rainier, as well as farther north and south in the Cascades. It is safe to assume that these Easton specimens are typical, especially as there is little variation shown throughout the Cascades of Washington. As at present known, the ranges of *arvicoloides* and *macropus* are widely separated, but no doubt they meet and coalesce in *richardsoni* of the Canadian Rockies.

Specimens examined.—Total number, 101, from the following localities:

Washington: Easton, 13; head of Cascade River, 2; Mount Rainier and vicinity, 34; Mount St. Helens, 4; Wenatchee, 1.

Oregon: Mount Hood, 11; Marmot, 1; Mount Jefferson, 2; Detroit, 1; Crater Lake, 22; Anna Creek, base of Mount Mazama, 10.

Subgenus PITYMYS[1] McMurtrie.

Psammomys Le Conte, Ann. Lyceum Nat. Hist. N. Y., III, 132, 1830. Type *Psammomys pinetorum* Le Conte. (Not *Psammomys* Cretzschmar, 1828).
Pitymys McMurtrie, Cuvier's Animal Kingdom, Am. edition, I, 434, 1831. Type *Psammomys pinetorum* Le Conte. (New name for *Psammomys* Le Conte.)

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[1] For full synonymy of the subgenus *Pitymys*, see Miller, N. Am. Fauna No. 12, 58, 1896.

Geographic distribution (in America).—Southeastern United States, mainly in Upper Austral zone, and a small area in the Tropical zone of southeastern Mexico.

Subgeneric characters.—Plantar tubercles, 5; mammæ, 4, two pairs of inguinal; lateral glands on hips in adult males; ears very small; tail short; fur short, dense, and glossy. *Skull* flat and wide, with quadrate braincase; bullæ small; molars narrow; $\underline{m3}$ with 2 closed triangles; $\overline{m1}$ with 3 closed and 2 open triangles; $\overline{m2}$ with anterior pair of triangles confluent; m3 with 3 transverse loops.

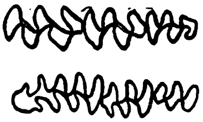

Fig. 11.—Molar enamel pattern of *Microtus* (*Pitymys*) *pinetorum* (×5).

MICROTUS PINETORUM (Le Conte). Pine Vole.

Psammomys pinetorum Le Conte, Ann. Lyc. Nat. Hist. N. Y., III, 133, Pl. II, 1830 (read Dec. 21, 1829).

Type locality.—Pine forests of Georgia. Probably the old Le Conte plantation at Riceboro.

Geographic distribution.—Georgia and the Carolinas.

Habitat.—Fields, open woods, and grassy uplands.

General characters.—Size small; ears very small; tail short; fur short and fine; colors bright.

Color.—Upperparts bright russet brown with a distinct gloss, becoming lighter on sides; belly dusky, lightly washed with color of back: tail brownish, darker above; feet grayish brown; ears concealed in the fur.

Cranial characters.—Skull short and wide with a quadrangular braincase and abruptly truncate occiput; interparietal wide and normally somewhat lozenge-shaped; mastoids and bullæ relatively small; interpterygoid fossa normally V-shaped. *Molar* series rather short and crowded; two middle triangles of $\underline{m3}$ often confluent; first pair of reentrant angles in m1 usually not meeting between anterior loop and first pair of salient angles.

Measurements.—Average of 2 adult females from Georgetown, S. C.: Total length, 113; tail vertebræ, 18.5; hind foot, 15.5. *Skull* (No. 1523, Merriam Coll., ♂ ad., from Frogmore, S. C.): Basal length, 22.3; nasals, 7.3; zygomatic breadth, 15; mastoid breadth, 12.5; alveolar length of upper molar series, 6.

General remarks.—No definite type locality was given in the original description of *pinetorum*, but the species was said to inhabit the sandy soil of the pine barrens of Georgia. Very probably the type came from the vicinity of the old Le Conte plantation, near Riceboro, Ga. Thirteen specimens in the Merriam collection, from Beaufort County, S. C., about 60 miles from Riceboro, are probably fairly typical, and are taken for the basis of the above description. They represent the extreme development of the bright cinnamon brown and small-eared form of the Atlantic coast region. Northward through the Atlantic States the specimens become darker and duller colored without other important modifications, except a slight average increase in size. The species described as *scalopsoides* from Long Island, and later as *apella* from Pennsylvania, includes this Northern form and seems worthy of recognition as a subspecies.

Specimens examined.—Total number, 32, from the following localities:

Georgia: Columbus, 2.
South Carolina: Beaufort County (Beaufort, Frogmore, and St. Helena Island), 13; Georgetown, 2; Society Hill, 1.
North Carolina: Old Richmond, 1; Raleigh, 11; Tarboro, 2.

MICROTUS PINETORUM SCALOPSOIDES (Aud. & Bach.). Mole like Vole.

Arvicola scalopsoides Aud. & Bach., Proc. Acad. Nat. Sci. Phila., I, 97, 1841.
Arvicola apella Le Conte, Proc. Acad. Nat. Sci. Phila., VI, 405, 1853. Type from Pennsylvania.
Arvicola kennicotti Baird, Mamm. N. Am., 547, 1857. Type from Illinois.

Type locality.—Long Island, New York.

Geographic distribution.—Southern New York and westward to Illinois, southward along the coast, blending into true *pinetorum*.

Habitat.—Open grassy country, meadows, pastures, and waste places.

General characters.—Larger, darker, and duller than true *pinetorum*.

Color.—Upperparts dull brownish chestnut, slightly darkened by dusky-tipped hairs; sides paler; belly lightly washed with dull buff over plumbeous under-fur; feet brownish gray; tail indistinctly bicolor, sooty above, grayish below.

Cranial characters.—Skull similar to that of *pinetorum*, but larger, with heavier molars.

Measurements.—Average of three adults from Lake Grove, Long Island: Total length, 125; tail vertebræ, 20; hind foot, 16.3. *Skull* (No. 88732, same locality): Basal length, 23.5; nasals, 7.4; zygomatic breadth, 16; mastoid breadth, 12.6; alveolar length of upper molar series, 6.6.

Specimens examined.—Total number, 83, from the following localities:

New York: Lake Grove, Long Island, 4; Millers Place, Long Island, 2; Oyster Bay, Long Island, 1; Sing Sing, 4; Lake George, 1; Locust Grove, 1.
Pennsylvania: Philadelphia, 1.
New Jersey: Tuckerton, 3.
Maryland: Laurel, 2; Kensington, 1; Bladensburg, 2.
District of Columbia: Washington, 27.
Virginia: Falls Church, 4; Dunn Loring, 1; Fort Myer, 1; Clark County, 2; Cape Charles, 4; Bellehaven, 1; Wallaceton (Dismal Swamp), 4.
North Carolina: Currituck, 2; Magnetic City, 1.
West Virginia: White Sulphur Springs, 6.
Ohio: A specimen in the U. S. Nat. Mus., collected by Kennicott, is labeled 'Ohio.'
Indiana: Brookville, 2 (approaching *auricularis*); Terre Haute, 1.
Illinois: West Northfield, 2; Warsaw, 2.

MICROTUS PINETORUM AURICULARIS Bailey. Bluegrass Vole.

Microtus pinetorum auricularis Bailey, Proc. Biol. Soc. Wash., XII, 90, April 30, 1898.

Type locality.—Washington, Mississippi.

Geographic distribution.—Northern Mississippi, Tennessee, Kentucky, and southern Indiana, or in a general way the region between the Allegheny Mountains and the Mississippi River, mainly in the Lower Austral zone.

General characters.—Size small, about equaling that of *pinetorum*; ears very large for a *Pitymys* and conspicuous above fur; colors dark and rich, not always darker than *scalopsoides* but richer and more intense; fur short and dense like that of *pinetorum*.

Color.—Upperparts dark rich chestnut darkened by dusky-tipped hairs; belly washed with paler chestnut over dark under-fur; projecting tip of ear with scattered dusky hairs; tail not bicolor, scarcely darker above, like the back or slightly darker; feet dull brownish.

Cranial characters.—Skull like that of *pinetorum* in form and general characters; interpterygoid fossa normally U-shaped instead of V-shaped.

Measurements.—Type: Total length, 120; tail vertebræ, 22; hind foot, 16. Average of six adult specimens from the type locality, measured in the flesh by collector: 119; 22; 17. *Skull* (of type): Basal length, 22.3; nasals, 7; zygomatic breadth, 15.2; mastoid breadth, 12.3; alveolar length of upper molar series, 6.

General remarks.—A series of 31 specimens in the Merriam collection from Eubank, Ky., average darker and richer in coloration than the type series and have equally large ears. Specimens from Brookville, Ind., are dark and dull colored and might pass for either this species or *scalopsoides*. A single specimen from Hickman, Ky., is immature but apparently typical. A flat skin with crushed skull from Barron Springs, near Fredericksburg, Tex., has the large ear and small foot of *auricularis* but the dull color of *nemoralis*.

Specimens examined.—Total number, 45, from the following localities:

Mississippi: Washington, 10.
Kentucky: Hickman, 1; Eubank, 31.
Indiana: Brookville, 1.
Tennessee: Rogersville, 1.
Alabama: Greensboro, 1.

MICROTUS NEMORALIS Bailey. Woodland Vole.

Microtus nemoralis Bailey, Proc. Biol. Soc. Wash., XII, 89, April 30, 1898.

Type locality.—Stilwell (Boston Mountains), Indian Territory.

Habitat.—Open woods and brushland.

Geographic distribution.—West of the Mississippi River from central Arkansas north to Council Bluffs, Iowa.

General characters.—Size, larger than any other species of *Pitymys* in the United States; ears, relatively large; fur, comparatively long and coarse; colors, duller than in *pinetorum*, not so dark as in *scalopsoides* or *auricularis*.

Color.—Upperparts dull chestnut, slightly lined with blackish-tipped hairs over the back and rump, becoming paler on the sides; belly washed with bright cinnamon; tail indistinctly bicolor; feet thinly clothed with pale buffy or sometimes dusky hairs. *Young:* Plumbeous or dark maltese, with a slight tinge of chestnut suffusing the back as maturity is approached.

Cranial characters.—Skull large and relatively elongated; supraoccipital sloping; interparietal short and wide; mastoids and audital bullæ large and projecting farther back than in *pinetorum;* palate often with a posterior point projecting into the U-shaped interpterygoid fossa.

Measurements.—Type: Total length, 130; tail vertebræ, 24; hind foot, 18. Average of five females and five males from the type locality: 135; 25; 18.1. *Skull* (of type): Basal length, 25.3; nasals, 7.7; zygomatic breadth, 16.5; mastoid breadth, 13.4; alveolar length of upper molar series, 7.

General remarks.—Specimens from London, Nebraska, and Council Bluffs, Iowa, are typical or slightly larger than those from the type locality. Those from central Arkansas and eastern Missouri are nearly or quite typical. So far as shown by the present series of specimens, the species stands distinct and apparently unconnected with the other forms of *Pitymys* east of the Mississippi River.

Specimens examined.—Total number, 46, from the following localities:

Indian Territory: Stilwell, Boston Mountains, 16.
Arkansas: Beebe, 5; Hardy, 1.
Missouri: Hunter, 3; Williamsville, 5; Kimswick, 5.
Iowa: Council Bluffs, 4.
Kansas: Neosho Falls, 1.
Nebraska: London, 6.

MICROTUS QUASIATER (Coues). Jalapa Vole.

Arvicola (*Pitymys*) *pinetorum quasiater* Coues. Proc. Acad. Nat. Sci. Phila., 1874, 191–192.

Type locality.—Jalapa, Vera Cruz, Mexico.

Geographic distribution.—Central Vera Cruz and eastern Puebla, on the east slope of the mountains (altitude 4,000 to 5,000 feet), in Humid Tropical and lower edge of Lower Austral zones.

Habitat.—Brushy woodland.

General characters.—Size of *pinetorum;* tail about as long as hind foot; ears large for a *Pitymys;* colors dark; fur glossy.

Color.—*Summer pelage:* Uniformly dark umber or seal brown, slightly paler on belly, feet, and tail; tail slightly paler below than above. *Winter pelage* (in January, specimens from Orizaba and Huauchinango): Darker, richer, and more glossy. *Young:* Darker and duller, inclining to sooty or plumbeous.

Cranial characters.—Skull similar to that of *pinetorum*, but with longer, more quadrate braincase, more prominent postorbital ridges, narrower interorbital space, and larger audital bullæ; dentition slightly heavier; molar pattern the same.

Measurements.—Average of 6 adult males and females from the type locality: Total length, 130; tail vertebræ, 23; hind foot, 17.7. *Skull* (No. 55048, ♀ adult): Basal length, 24; nasals, 7; zygomatic breadth, 12; alveolar length of upper molar series, 6.3.

General remarks.—*Microtus quasiater* is by far the most divergent form of *Pitymys* in America. Its range, so far as known, is restricted to a comparatively small area, 1,000 miles from that of its nearest relative, and reaches into a zone not known to be inhabited by any other species of *Microtus*.

Specimens examined.—Total number, 44, from the following localities:

Vera Cruz: Jalapa, 6; Jico, 8; Orizaba, 10.
Puebla: Huauchinango, 20.

Subgenus LAGURUS Gloger.

Lagurus Gloger, Gemeinnütz. Hand- u. Hilfsbuch d. Naturgesch., I, 98, 1841. Type *Lagurus migratorius* Gloger.

Lagurus Merriam, Am. Naturalist, XXIX, 758, Aug., 1895 (subgenus).

Geographic distribution (in America).—Transition zone of the semiarid parts of the northwestern United States, east of the Cascades and Sierra Nevada.

Subgeneric characters.—(In American species) plantar tubercles, 5; mammæ, 8, inguinal 2–2, pectoral, 2–2; lateral glands on flanks; tail little little longer than hind foot; colors pale; fur lax. *Skull* low and wide; bullæ very large; mastoids reaching plane of exoccipital condyles; molars slender, with wide reentrant angles; m3 with 2 closed triangles and narrow posterior loop; m1 with 5 closed triangles, 4 inner and 4 outer salient angles; $\overline{\text{m3}}$ with two terminal transverse loops and a pair of median triangles.

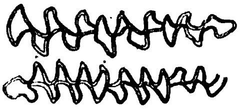

FIG. 12.—Molar enamel pattern of *Microtus* (*Lagurus*) *pallidus* (× 5).

MICROTUS CURTATUS (Cope). Short-tailed Vole.

Arvicola curtata Cope, Proc. Acad. Nat. Sci. Phila., 1868, 2.

Arvicola decurtata Coues, Mon. N. Am. Rodentia, 215 (in text), 1877, nomen nudum.

Type locality.—Pigeon Spring, Mount Magruder, Nevada.

Geographic distribution.—Transition zone of the low mountain ranges in western Nevada and eastern California, east of the Sierra Nevada and north of Death Valley.

Habitat.—Dry, barren country, usually in sagebrush.

General characters.—Tail very short; feet hairy; fur long and lax; color pale buffy gray; skull wide and flat, with very large audital bullæ.

Color.—*Winter pelage:* Upperparts uniform pale buffy gray, or ashy gray becoming paler on the sides, and silvery white or soiled whitish below; tail like belly, except an indistinct dusky dorsal line; ears slightly buffy, more noticeably so in young than in adults; feet soiled silvery whitish. *Summer pelage:* Slightly darker. *Young:* Darkened above by long, dusky-tipped hairs; ears distinctly buff tipped.

Cranial characters.—Skull wide and flat, with short rostrum, spreading zygomatic arches, and great mastoid breadth; audital bullæ and mastoids much inflated, and with thick, spongy walls; mastoids projecting back to plane of exoccipital condyles. Molar series rather light, with narrow, tightly closed triangles and wide reentrant angles.

Measurements.—Average of five adults from the type locality: Total length, 141; tail vertebræ, 27; hind foot, 17.6. *Skull* (No. 41019, ♀ ad.): Basal length, 24; nasals, 6.6; zygomatic breadth, 15; mastoid breadth, 13; alveolar length of upper molar series, 6.

General remarks.—This is the largest of the three species of *Lagurus* at present known in North America, size alone being sufficient to distinguish it from either *pauperrimus* or *pallidus*. It shows but slight variation throughout its somewhat restricted and probably interrupted range. Specimens from the head waters of Reese River, which is separated from the type locality by Sonoran valleys, show slightly larger audital bullæ and mastoids, but no characters of specific or subspecific value.

Specimens examined.—Total number, 54, from the following localities:

Nevada: Mount Magruder (near Pigeon Spring), 14; Reese River Valley, 7; Indian Creek (near head of Reese River), 2; head of Reese River, 10.
California: Inyo Mountains, 17; White Mountains, 4.

NOTE.—*Microtus* (*Lagurus*) *pumilus* Elliot (Field Columbian Museum, Zool. Series, Vol. I, No. II, p. 226, Feb. 1, 1899) from the Olympic Mountains, Washington, proves to be a young *Phenacomys*, as I have ascertained by examination of the type specimen, kindly loaned me by Mr. D. G. Elliot, curator of mammals in the Field Columbian Museum.

MICROTUS PALLIDUS (Merriam.) Pallid Vole.

Arvicola pallidus Merriam, Am. Nat., XXII, 702-705, Aug., 1888.

Type locality.—Fort Buford, N. Dak. The type was taken on a northeast slope, near the top of a high, barren hill, 2 miles east of the fort.

Geographic distribution.—Transition prairies of western North Dakota, Montana, and as far north as Calgary, Alberta.

Habitat.—High, semi-arid prairies, usually on shady slopes.

General characters.—Slightly paler than *curtatus;* smaller; with relatively much smaller audital bullæ. The palest species of *Microtus* found in America, and probably the shortest tailed.

Color.—Upperparts uniform pale buffy gray with an extra tinge of buff about ears and nose; belly white or soiled whitish; tail silvery whitish below, dusky above; feet silvery whitish or pale gray. The type series was taken in September and shows what is probably the darkest phase of summer pelage.

Cranial characters.—Skull like that of *curtatus* in general, but averaging slightly smaller and with decidedly smaller audital bullæ and narrower mastoid breadth. Teeth relatively heavy; incisors fully equaling those of larger skulls of *curtatus;* molar series heavy and actually longer in the smallest adults than in much larger specimens of *curtatus;* enamel pattern essentially the same.

Measurements.—Type, ♀ ad.: Total length, 121; tail vertebræ, 20; hind foot, 18 (measured dry). *Skull* (of type): Basal length, 22.3; nasals, 6.5; zygomatic breadth, 14.6; mastoid breadth, 11.6; alveolar length of upper molar series, 6.3.

General remarks.—In size *pallidus* falls between *curtatus* and *pauperrimus*, but in relative size of teeth *curtatus* comes in the middle, while in geographic position *pauperrimus* separates the other two. There is nothing in the material before me to indicate any intergradation between the forms or any subspecific relationship.

Specimens examined.—Total number, 8, from the following localities:

North Dakota: Fort Buford, 4.
Montana: Philbrook, 1.
Canada: Calgary, Alberta, 3.

MICROTUS PAUPERRIMUS (Cooper). Pigmy Vole.

Arvicola pauperrima Cooper, Am. Nat., II, 535–536, Dec., 1868.

Type locality.—Plains of the Columbia, near Snake River, Washington.

Geographic distribution.—Eastern Washington and Oregon, central Idaho, and the north slope of the Uinta Mountains, Utah, in Transition zone.

Habitat.—Open grassy ridges or high prairie, except in the Uinta Mountains, where they were found in grassy parks near the lower edge of pine timber.

General characters.—The smallest species of the subgenus *Lagurus*, with colors a shade darker than in *curtatus* or *pallidus;* skull small and very flat-topped, often concave postorbitally.

Color.—*Summer pelage:* Upperparts uniform buffy gray, slightly darkened with dusky-tipped hairs; ears and nose strongly tinged with buff; belly pale buffy; tail darkened above by a dusky line, buffy below; feet like belly. *Young:* Less buffy and slightly more dusky than adult.

Cranial and dental characters.—Skull small, relatively smooth, not ridged or angled, flat or concave on top; audital bullæ relatively as well as actually smaller than in *curtatus;* hamular process of mandible short and slender, inclosing a wide two-angled or rounded notch; incisors slender; molars differing from those of *curtatus* only in smaller size; enamel pattern essentially the same.

Measurements.—Average of 3 adults from the vicinity of Antelope, Oreg.: Total length, 115; tail vertebræ, 20; hind foot, 16. *Skull* (of adult ♀, No. 78534, from Antelope, Oreg.): Basal length, 20; nasals, 5.5; zygomatic breadth, 13.4: mastoid breadth, 11.3; alveolar length of upper molar series, 5.2.

General remarks.—The above description is based mainly on a series of 6 specimens collected near Antelope, Oreg., on top of the high prairie ridge between the John Day and Des Chutes rivers, and not more than 150 miles from where Dr. J. G. Cooper collected his type of *pauperrimus* on the plains of the Columbia, near Snake River, October 9, 1860. Antelope is in reality on the south edge of the plains of the Columbia, and specimens from that point agree in every way with the somewhat mutilated type of *pauperrimus* still in the United States National Museum. Specimens from the Salmon River Mountains, Idaho, do not differ perceptibly from the type or from the Antelope series. A single specimen from the top of Steen Mountain is not typical, but the characters are not sufficient to warrant separating it on a single specimen, and they may prove only individual. Four specimens from the north slope of the Uinta Mountains, Utah, show but litttle deviation from the typical series.

Specimens examined.—Total number, 19, from the following localities:

Washington: Plains of the Columbia, 1 (the type).
Oregon: Antelope, 6; Bake Oven, 1 (im.); Steen Mountain, 1.
Idaho: Salmon River Mountains, 6.
Utah: Uinta Mountains, 4.

Subgenus CHILOTUS Baird.

Chilotus Baird, Mamm. N. Am., 516, 1857. Type, *Arvicola oregoni* Bachman.

Geographic distribution.—Pacific slope from northern California to southern British Columbia.

Subgeneric characters.—Plantar tubercles, 5; mammæ, 8, inguinal, 2–2; pectoral, 2–2; side glands obscure or wanting;[1] ears rather small; fur dense, without stiff hairs. *Skull* short, low, and with elliptical braincase; molars small; m3 with 2 or 3 closed triangles; m1 with 5 closed triangles; m2 with anterior pair of triangles usually confluent; m3 with 3 transverse loops.

MICROTUS OREGONI (Bachman). Oregon Vole.

Arvicola oregoni Bachman, Journ. Acad. Nat. Sci. Phila., VIII, Pl. 1, 60–61, 1839.
Microtus morosus Elliot, Field Columbian Mus., Zool. Series, Vol. I, No. II, 227, Feb. 1, 1899. (Olympic Mountains, Washington.)

Type locality.—Astoria, Oregon.

Geographic distribution.—Pacific coast region from northern California to Puget Sound.

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[1] In a large number of skins of adult males, about a dozen show what appear to be ill-defined glands on the sides, midway between hips and shoulders; but before stating postively the presence and position of these glands it will be necessary to examine specimens in the flesh.

Habitat.—Dry open ground, under cover of grass and low vegetation, and under logs in the open redwood forest of California.

General characters.—Size rather small; tail long; colors dark; fur short, without long hairs.

Color.—Upperparts mixed bister and blackish, with a pepper-and-salt appearance; belly dusky, lightly washed with dull buffy; feet dusky gray; tail blackish, slightly lighter below; ears blackish, scantily haired, protruding from the fur.

Cranial characters.—Skull, compared with those of other species ot the subgenus, long and slender, with narrower braincase, longer rostrum, more arched and less abruptly spreading zygomata, more quadrangular interparietal; superciliary ridges in adults well marked, approaching or meeting interorbitally; audital bullæ small and globose; dentition not peculiar.

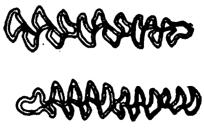

FIG. 13.—Molar enamel pattern of *Microtus* (*Chilotus*) *oregoni* (× 5).

Measurements.—Adult ♂, No. $\frac{17330}{24255}$, from Astoria: Total length, 140; tail vertebræ, 42; hind foot, 17. *Skull* (of same): Basal length, 22.2; nasals, 17; zygomatic breadth, 14.8; mastoid breadth, 11.8; alveolar length of molar series, 5.5.

General remarks.—The species shows some slight variation throughout its range, but all of the specimens examined from the low country south of Puget Sound are clearly referable to *oregoni*, and those from timberline in the Olympics do not vary sufficiently for even subspecific recognition.

Specimens examined.—Total number, 103, from the following localities:

Oregon: Astoria, 6; Oregon City, 6; Yaquina Bay, 1; Aumsville, 1; Elk Head, 1.

California: Crescent City, 12; Humboldt Bay, 1; Hoopa Valley, 2; Dyerville, 3.

Washington: Tenino, 9; Roy, 1; Skamania County (45 miles southeast of Toledo), 1; Kent, 2; Steilacoom, 1; Aberdeen, 3; Granville, 6; Quineault Lake, Chehalis County, 3; La Push, 3; Suez, 1; Neah Bay, 10; Olympic Mountains (near head of Soleduc River), 9; Lake Cushman, 21.

MICROTUS SERPENS Merriam. Creeping Vole.

Microtus serpens Merriam, Proc. Biol. Soc. Wash., XI, 75, 1897.

Type locality.—Agassiz, British Columbia.

Geographic distribution.—Low country of southern British Columbia and northern Washington between the Cascade Mountains and Puget Sound.

General characters.—Size, largest of the subgenus; tail short; colors dark.

Color.—*Winter pelage:* Upperparts uniformly sooty gray, becoming slightly lighter on sides; belly dusky, washed with dull buff; tail sooty above, silvery gray below; feet dusky gray; ears nearly naked, concealed in long fur. *Summer pelage:* Paler and more brownish above, belly lightly washed with buffy; ears projecting slightly from thinner, coarser fur.

Cranial characters.—Skull rather wide and short; superciliary ridges not well defined; interorbital width greater than in *oregoni;* zygomata abruptly spreading anteriorly, interparietal lozenge-shaped; audital bullæ full and globose; incisors larger and stronger and molars slightly larger than in *oregoni.*

Measurements.—Type: Total length, 130; tail vertebræ, 31; hind foot, 18. Average of 7 adults from type locality: 129; 32; 17.5. *Skull* (of type): Basal length, 22.4; nasals, 6.6; zygomatic breadth, 14; mastoid breadth, 11.2; alveolar length of upper molar series, 5.9.

General remarks.—The range of this northern, more robust form of *Chilotus*, as at present known, is rather limited, but future collections may show it to be continuous with that of *oregoni.*

Specimens examined.—Total number, 56, from the following localities:

British Columbia: Agassiz, 7; Port Moody, 10; Langley, 3; Sumas, 10; Mount Baker Range, 4.

Washington: Mount Vernon, 19; Hamilton, 2; Sauk, 1.

MICROTUS BAIRDI Merriam. Baird Vole.

Microtus bairdi Merriam, Proc. Biol. Soc. Wash., XI, 74, 1897.

Type locality.—Glacier Peak, Crater Lake, Oregon (altitude, 7,800 feet).

Geographic distribution.—Known only from the type locality, but probably restricted to the Hudsonian zone of the higher Cascades.

Habitat.—Beds of *Phyllodoce* and *Lutkea* at timberline.

General characters.—Slightly smaller than *M. oregoni;* color yellowish brown; fur short and glossy; tail short; ears almost concealed in the fur.

Color.—Upperparts glossy yellowish bister; sides paler; belly washed with whitish; tail indistinctly bicolor, dusky above, dark gray below; feet dusky gray; nose dusky.

Cranial characters.—Skull relatively short, wide, and flat, with short rostrum; braincase subquadrate; interparietal narrow; audital bullæ large; ascending arm of premaxillæ not extending beyond nasals; incisive foramina short and wide; dentition not peculiar.

Measurements.—Type, No. 79906, ♀ ad.: Total length, 131; tail vertebræ, 33; hind foot, 17.5. A young adult ♂ from type locality: 130; 32; 17. *Skull* (of type): Basal length, 22; nasals, 6.6; zygomatic breadth, 14; mastoid breadth, 11.5; alveolar length of upper molar series, 5.5.

General remarks.—This species of *Chilotus* is as yet known only from 2 specimens from the type locality. No doubt it will eventually be found to extend along the crest of the Cascade Range in Oregon.

Specimens examined.—Total number, 2, from the type locality.

Subgenus PEDOMYS Baird.

Pedomys Baird, Mamm. N. Am., 517, 1857. Type, *Arvicola austerus* Le Conte.

Geographic distribution.—Middle United States from southern Louisiana to Plains of the Saskatchewan.

Subgeneric characters.—Plantar tubercles, 5; side glands obscure or wanting,[1] rarely discernible; mammæ, 6, inguinal, 2–2, pectoral, 1–1; ears medium; fur long and coarse. *Skull* high and narrow; molars with wide reentrant angles; $\underline{m3}$ with 2 closed triangles; $\overline{m1}$ with 3 closed and 2 open triangles; $\underline{m2}$ with anterior pair of triangles confluent; $\overline{m3}$ with 3 transverse loops, the middle loop sometimes constricted, or even divided into 2 triangles.

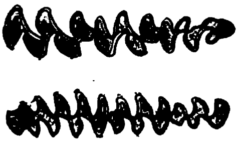

FIG. 14.—Molar enamel pattern of *Microtus* (*Pedomys*) *austerus* (×5).

MICROTUS AUSTERUS (Le Conte). Prairie Vole.

Arvicola austerus Le Conte, Proc. Acad. Nat. Sci. Phila., VI, 405–406, 1853.

Arvicola (*Pedomys*) *cinnamonea* Baird, Mamm. N. Am., 541, 1857. (Type from Pembina, N. Dak.)

Type locality.—Racine, Wisconsin.

Geographic distribution.—Central part of Mississippi Valley from southern Wisconsin to southern Missouri and Fort Reno, Oklahoma, and west into eastern Nebraska and Kansas.

Habitat.—Dry upland prairie under low grass, and in rose and hazel thickets.

General characters.—Size of *Microtus pennsylvanicus*, but with slightly shorter tail and apparently coarser pelage. Color, dark peppery gray above, dull fulvous below.

Color.—*Winter pelage:* Upperparts dark gray, with a peppery appearance from the mixture of black and pale fulvous tips of long hairs, black tips predominating; sides paler; belly washed with pale cinnamon or fulvous; tail sharply bicolor, feet dusky; a tuft of fulvous hairs in front of ear. *Summer pelage:* Darker throughout, with fewer light-tipped hairs and thinner fulvous wash below. *Young:* Slightly paler than adult.

Cranial characters.—Skull high, narrow, and well arched; interparietal small, lozenge shaped; premaxillæ extending well back of nasals; audital bullæ small and narrow; incisive foramina wide posteriorly; molar pattern, that of the subgenus.

Measurements.—No. 2928, ♂ ad., from Racine, Wis., (measured from alcohol by Baird)[2]: Total length, 127; tail vertebræ, 32; No. 2897: hind foot, 19. *Skull* (No. 1999, ad., from Racine): Basal length, 27; nasals, 7.9; zygomatic breadth, 15.5; mastoid breadth, 12.6; alveolar length of upper molar series, 6.8. *Skull* (No. 948—not fully adult—from Racine): 25; 7.9; 15.4; 11.8; 6.

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[1] A large number of skins of males show no trace of side glands, but a few show what appear to be very small glandular areas on the middle of the sides. It will be necessary to examine fresh specimens of old males before the presence or position of the glands is fully determined.

[2] Mamm. N. Am., 541, 1857.

Considerable variation is shown throughout the range of the species. To the southwest, at Orlando and Fort Reno, Okla., the individuals show slightly deeper coloration and slight modifications of cranial characters. Except for a slightly abnormal tooth pattern Baird's type of *cinnamonea* is a large specimen of typical ***austerus***. I cannot believe that it ever came from Pembina.

Specimens examined.—Total, 211, from the following localities:

Wisconsin: Racine, 4.
Illinois: West Northfield, 14; Warsaw, 1.
Indiana: Wheatland, 4.
Iowa: Fairfield, 1; Knoxville, 93.
Nebraska: Blair, 1 (im.) Columbus, 7; London, 13; Norfolk, 1.
Kansas: Cairo, 4; Onaga, 13; Burlington, 1; Doniphan County, 1; Fort Leavenworth, 21.
Missouri: Golden City, 2; Piedmont, 10; Bismark, 6; Kimswick, 6.
Oklahoma: Orlando, 1; Fort Reno, 7.

MICROTUS LUDOVICIANUS sp. nov. Louisiana Vole.

Type from Iowa, Calcasieu Parish, Louisiana. No. 96624, ♂ ad., U. S. Nat. Mus., Biological Survey Collection. Collected April 7, 1899, by Vernon Bailey. Collector's number, 6767.

Geographic distribution.—Coast prairie of southwestern Louisiana, in Lower Austral zone.

Habitat.—Dry grassy mounds on the flat, half-marshy coast prairie.

General characters.—Size and proportions about as in ***M. austerus***, color similar; rostrum and nasals slenderer and audital bullæ larger.

Color.—*Winter pelage* (in April specimens): Upperparts dark gray, with a coarse, peppery appearance, produced by the mixture of black-, brown-, and whitish-tipped hairs, and varying in color as these different colored hairs predominate; below dull fulvous or dark buffy; tail indistinctly bicolor, dusky above, buffy below; feet dusky. *Young* (quarter to half grown): Darker, more dusky, and less brownish than adult.

Cranial characters.—Skull like that of ***austerus*** with larger, more rounded audital bullæ, larger molars, and slenderer nasals. Middle section of m3 often constricted or separated into two closed triangles. (This may occur in any species of *Pedomys*.)

Measurements.—Average of 10 adults (5 males and 5 females) from type locality: Total length, 164; tail vertebræ, 33; hind foot, 18.5. Average of hind foot of males, 19; of females, 18. Type: 146; 36; 19. *Skull* (of type): Basal length, 25.8; nasals, 8; zygomatic breadth, 15; mastoid breadth, 11.5; alveolar length of upper molar series, 6.3.

Remarks.—A single imperfect skull in the United States National Museum collection from Calcasieu Parish, La., showed such pronounced characters as to suggest the collection of the present series of specimens. Some of the characters in the old skull prove to be abnormal, and the actual differences between this southern form and true ***austerus*** are not strongly marked. There is no known and probably no actual intergradation or continuity of range between the two forms, and perhaps subspecific rank would show better the close relationship of *ludovicianus* to *austerus*.

Specimens examined.—Total number, 26, from Calcasieu Parish, La.

MICROTUS HAYDENI (Baird). Hayden Vole.

Arvicola haydeni Baird, Mamm. N. Am., 543–544, 1857.

Type locality.—Fort Pierre, South Dakota.

Geographic distribution.—Plains region of western South Dakota, Nebraska, and Kansas, eastern Colorado and Wyoming, and southern Montana, in Transition zone.

Habitat.—Dry prairies. At the type locality, in sagebrush on badland hills.

General characters.—Considerably larger and lighter colored than *M. austerus*, with little or none of the fulvous or cinnamon wash below; fur very long and lax in winter and spring pelages; skull heavy and angular.

Color.—(May specimens from Fort Pierre): Upperparts uniform light gray, the color formed by a combination of whitish- and blackish-tipped hairs, with the white-tipped predominating; belly washed with silvery white, or sometimes soiled white, over plumbeous under-fur; feet dusky gray; tail bicolor. *Summer pelage:* Somewhat darker, with sometimes a slight wash of buff below. *Young* (one-fourth to one-half grown): Very woolly and slightly darker than adult.

Cranial characters.—Skull larger, more angular, and more heavily ridged than in *austerus;* anterior part of zygomatic arches more abruptly spreading; prezygomatic notch deeper; interparietal larger; palate higher, with more prominent median ridge.

Measurements.—Adult ♀ from type locality (No. 4239, Merriam Coll.): Total length, 180; tail vertebræ, 47; hind foot, 22. *Skull* (No. 4971 from Fort Pierre): Basal length, 28; nasals, 8; zygomatic breadth, 17.6; mastoid breadth, 12.6; alveolar length of upper molar series, 7.4.

General remarks.—Probably *haydeni* intergrades with true *austerus*, and is merely a more robust and paler northwestern form. The ranges of the two almost meet, if they are not continuous.

Specimens examined.—Total number, 110, from the following localities:

South Dakota: Fort Pierre, 4; Pierre, 3; Buffalo Gap, 4; Rapid City, 4.
Nebraska: Valentine, 10; Kennedy, 11; Sidney, 2; Callaway, 4; Alliance, 2.
Kansas: Pendennis, 10; Banner, 11.
Colorado: Loveland, 1; Canyon City, 1.
Wyoming: Beaver, 1; Newcastle, 1; Sundance, 1; Dayton, 1; Pass, 4.
Montana: Little Bighorn Valley, 8; Fort Custer, 24; Custer Station, 1; Lake Basin, 2.

MICROTUS MINOR (Merriam). Least Upland Vole.

Arvicola austerus minor Merriam, Am. Nat., XXII, 598–601, July, 1888.

Type locality.—Bottineau, at base of Turtle Mountains, North Dakota.

Geographic distribution.—Northern border of the Great Plains from northeastern North Dakota to Edmonton, Alberta, and southeastward to Minneapolis, Minn.

Habitat.—Dry upland prairie.

General characters.—Size very small, scarcely as large as *Evotomys gapperi* and of about the same proportions; color peppery gray; pelage long, lax, and coarse; sixth tubercle on hind foot usually present, though small; skull small and slender.

Color.—*Winter pelage:* Upperparts uniform, clear peppery gray, from a combination of black- and whitish-tipped hairs; belly washed with soiled white or pale buffy; tail sharply bicolor, dusky above, buffy below; feet gray. *Summer pelage:* With a mixture of fulvous above; belly with thinner wash of light-tipped hairs over dark under-fur. *Young:* Slightly darker than adult with less peppery appearance of fur.

Cranial characters.—Skull very small, not much arched, slender and narrow, with relatively heavy rostrum, narrow strap-shaped interparietal and slender zygomata; audital bullæ small and laterally compressed; molars with enamel pattern of the subgenus.

Measurements.—Type: Total length, 133; tail vertebræ, 36; hind foot, 16.5. Average of four adults from Sherbrook, N. Dak.: 128; 30; 16.7. *Skull* (No. 49230, ♀ ad., from Sherbrook): Basal length, 22.3; nasals, 6.4; zygomatic breadth, 12.2; mastoid breadth, 10; alveolar length of upper molar series, 5.

General remarks.—A mere glance at the skulls shows *minor* to be widely separated from any other species of the subgenus, differing from *austerus* in much smaller size, narrower braincase, and relatively smaller and narrower audital bullæ. The species shows little variation throughout its range over the prairie region, but those occupying the half-timbered region of south-central Minnesota show a marked intensity of color.

Specimens examined.—Total number, 94, from the following localities:

North Dakota: Bottineau, 3; Sherbrook, 4; Devils Lake, 1.
South Dakota: Traverse, 7.
Minnesota: Ortonville, 6; Elk River, 40; Fort Snelling, 7; Hamlington, 1.
Canada: Carberry, Manitoba, 1; Indian Head, Assinaboia, 11; Wingard, Saskatchewan, 10; Red Deer, Alberta, 1; Edmonton, Alberta, 2.

Subgenus ORTHRIOMYS Merriam.

Orthriomys Merriam, Proc. Biol. Soc. Wash., XII, 107, April 30, 1898. Type, *Microtus umbrosus* Merriam.

Geographic distribution.—That of its only known species.

Subgeneric characters.—Plantar tubercles, 5 (a rudiment of 6th); side glands wanting or very rudimentary; mammæ, 4, pectoral, 2–2; ears large and almost naked; feet large; tail long and scantily haired. *Skull* long and narrow; bullæ very small; posterior median ridge of palate sloping and grooved; m3 with 2 closed rounded triangles, and a third open one; $\overline{m}1$ with 3 closed triangles, 4 inner and 3 outer salient angles; $\overline{m}2$ with the anterior pair of triangles confluent; $\overline{m}3$ with 4 closed sections including 2 median triangles.

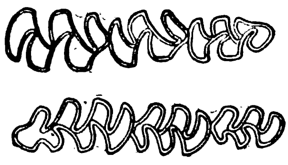

FIG. 15.—Molar enamel pattern of *Microtus* (*Orthriomys*) *umbrosus* (x 5).

MICROTUS UMBROSUS Merriam. Zempoaltepec Vole.

Microtus umbrosus Merriam, Proc. Biol. Soc. Wash., XII, 108, Apr. 30, 1898.

Type locality.—Mount Zempoaltepec, Oaxaca, Mexico (altitude 8,200 feet).

Geographic distribution.—Known only from the east slope of Mount Zempoaltepec, in the humid Upper Austral zone.

Habitat.—Dense oak forests, living in burrows and long underground tunnels.

General characters.—Size rather large; tail long; ears large; fur long and lax; colors dark; skull long and flat, with small bullæ and peculiar dentition.

Color.—Upperparts uniform dusky, with brown-tipped hairs; below dark plumbeous thinly washed with fulvous; feet and tail thinly haired, concolor, dark brown.

Cranial characters.—Skull long, narrow, and but little arched, with smooth outlines, and slender zygomatic arches; bullæ very small; palate low, with slender or incomplete lateral bridges, shallow lateral pits and grooved posterior ridge; interpterygoid fossa wide and quadrate; incisive foramina short and widest in the middle. Dentition heavy; incisors abruptly decurved; inner salient 'angles' of upper and posterior lower molars rounded instead of acute; m3 with a small outer and a large inner closed triangle and a posterior trefoil with large inner and small outer lobe; m3 with 2 median closed triangles, an outer and inner, and broad terminal loops.

Measurements.—Average of 7 specimens from type locality: Total length, 184; tail vertebræ, 65; hind foot, 23. Type: 177; 61; 23.5.

Skull (of type): Basal length, 26.5; nasals, 7.3; zygomatic breadth, 16; mastoid breadth, 12; alveolar length of upper molar series, 7.

Specimens examined: Total number, 15; from the following localities in Mexico.

Oaxaca: Mount Zempoaltepec (above Totontepec), 8; Totontepec, 7.

Subgenus **HERPETOMYS** Merriam.

Herpetomys Merriam, Proc. Biol. Soc. Wash., XII, 107, April 30, 1898. Type, *Microtus guatemalensis* Merriam, from Todos Santos, Guatemala.

Geographic distribution.—That of the type species.

Subgeneric characters.—Plantar tubercles, 5; side glands[1] on flanks of males small and obscure or sometimes wanting; mammæ, 6, pectoral, 2–2, inguinal, 1–1 (the latter apparently rudimentary and functionless); ears large; pelage long and soft; colors dark brownish. *Skull* with smooth outlines and large globose audital bullæ; $\underline{\text{m3}}$ with 3 closed triangles; $\overline{\text{m1}}$ with 3 closed triangles and an interior confluent pair of triangles opening into terminal loop, and with 5 inner and 4 outer salient angles; $\overline{m}3$ with 4 closed sections including a pair of subequal median triangles.

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[1] In some specimens no side glands can be discovered, and in others they are marked by a pencil of white hairs. There is some doubt as to whether the white hairs are a product of the glands or occur there accidentally or from injury, as they sometimes do over other parts of the body.

MICROTUS GUATEMALENSIS Merriam. Guatemalan Vole.

Microtus guatemalensis Merriam, Proc. Biol. Soc. Wash., XII, 107, April 30, 1898.

Type locality.—Todos Santos, Huehuetenango, Guatemala (altitude 10,000 feet).

Geographic distribution.—Known only from type locality.

Habitat.—Open ground on damp north slopes under rank growth of brush and weeds in the Boreal zone (altitude 9,800–11,000 feet).

General characters.—Size medium; tail less than twice the length of hind foot; ears large but nearly concealed in the long fur; colors dark.

Color.—*Winter pelage:* Upperparts dark umber brown; nose blackish; lips white; belly clear plumbeous or lightly washed with dull ochraceous; feet and tail dusky brown, concolor, and thinly haired. (*Summer pelage* not seen.) *Young* (half-grown individuals in December): Slightly duller than adult.

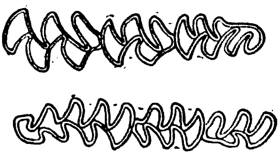


FIG. 16.—Molar enamel pattern of *Microtus* (*Herpetomys*) *guatemalensis* (× 5).

Cranial characters.—Skull rather long and but little arched, without conspicuous ridges and angles; interorbital space wide; braincase long; bullæ large and globose (larger than those of any other Mexican species); palate with steep and lightly grooved posterior median ridge; incisive foramina wide and short. *Dentition* heavy; most of the salient angles of molars acute; prisms deltoid; $\underline{m3}$ with anterior crescent, 3 closed triangles, and a posterior crescent with two inner horns; $\overline{m}3$ with posterior and anterior transverse crescents and a pair of subequal median triangles.

Measurements.—Average of 20 specimens from the type locality: Total length, 150; tail vertebræ, 37; hind foot, 21. Type (♂ ad.): 155; 40; 21. *Skull* (of type): Basal length, 25.6; nasals, 7.6; zygomatic breadth, 15; mastoid breadth, 12.3; alveolar length of upper molar series, 7.

General remarks.—So far as at present known, this is the southernmost species of *Microtus* in America. Its nearest relatives are *umbrosus* and *mexicanus*, with both of which it has some characters in common, but from which it differs so widely as to require subgeneric separation.

Specimens examined: Total number, 34, from the type locality.

Subgenus NEOFIBER True.

Neofiber True, Science, IV, 34, July 11, 1884 (genus). Type, *Neofiber alleni* True.

Neofiber Merriam, North American Fauna No. 5, 59, July, 1891 (subgenus).

Geographic distribution.—That of the type species.

Subgeneric characters.—Plantar tubercles, 5; side glands conspicuous in both sexes and in young, situated half-way between hips and shoulders, the glandular area marked by brownish base of fur and half-encircled above by a semilunar area of fur with white base; mammæ, 6, inguinal, 2–2, pectoral, 1–1; feet and fur modified for aquatic life; soles naked; a dorsal keel of long hair on rump. *Skull* massive; palate long with incomplete lateral bridges; pterygoids wing-like; $\underline{m}3$ with 2 closed triangles; $\overline{m}1$ with 5 closed triangles; $\overline{m}3$ with 2 median triangles and 2 transverse terminal loops.

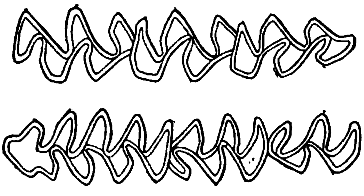


FIG. 17.—Molar enamel pattern of *Microtus* (*Neofiber*) *alleni* (× 5).

MICROTUS ALLENI (True). Florida Water-Rat,

Neofiber alleni True, Science, IV, 34, July 11, 1884.
Microtus (*Neofiber*) *alleni* Miller, North American Fauna No. 12, 70, July 23, 1896.

Type locality.—Georgiana, Brevard County, Florida.

Geographic distribution.—Eastern and central Florida.

Habitat.—Marshes, shallow lakes, and banks of streams.

General characters.—In appearance very similar to a small muskrat, but with a round tail, a tuft of long hair above the tail, hind feet less modified for aquatic life; fur dense, with color and texture of muskrat fur; skull resembling that of the muskrat, but with the rootless molars of *Microtus*.

Color.—Upperparts dark brown, darkened on head and along back by coarse blackish hairs; nose black; chin dusky; belly pale buff or soiled silvery whitish; tail dark brown or blackish, darker toward the tip; feet dark brown. *Young:* Dark maltese, with sooty backs.

Cranial characters.—Skull high and short, with heavy ridges and sharp angles; prezygomatic notches deep; postorbital shelf projecting; palate bone longer than in any other *Microtus*, shorter than in *Fiber;* lateral bridges of palate interrupted; pterygoids wing-like (as in *Fiber*); dentition heavy; upper incisors bent abruptly downward.

Measurements.—Average of 3 adult specimens from Canaveral, Fla.: Total length, 320; tail vertebræ, 121; hind foot, 44. Largest adult, ♂ : 330; 130; 44. *Skull* (No. 23450, ♀ ad.): Basal length, 44.6; nasals, 12.5; zygomatic breadth, 26; mastoid breadth, 20.5; alveolar length of upper molar series, 12.

General remarks.—The striking resemblance between *M. alleni* of Florida and *M. amphibius* of England proves on comparison of cranial characters to be only superficial; the differences are subgeneric.

Specimens examined: Total number, 17, from the following localities:

Florida: Georgiana, 3; Titusville, 1; Eden, 3; Canaveral, 5; Geneva, 3; Lake Harney, 1; Oaklodge (on peninsula opposite Micco), 1.

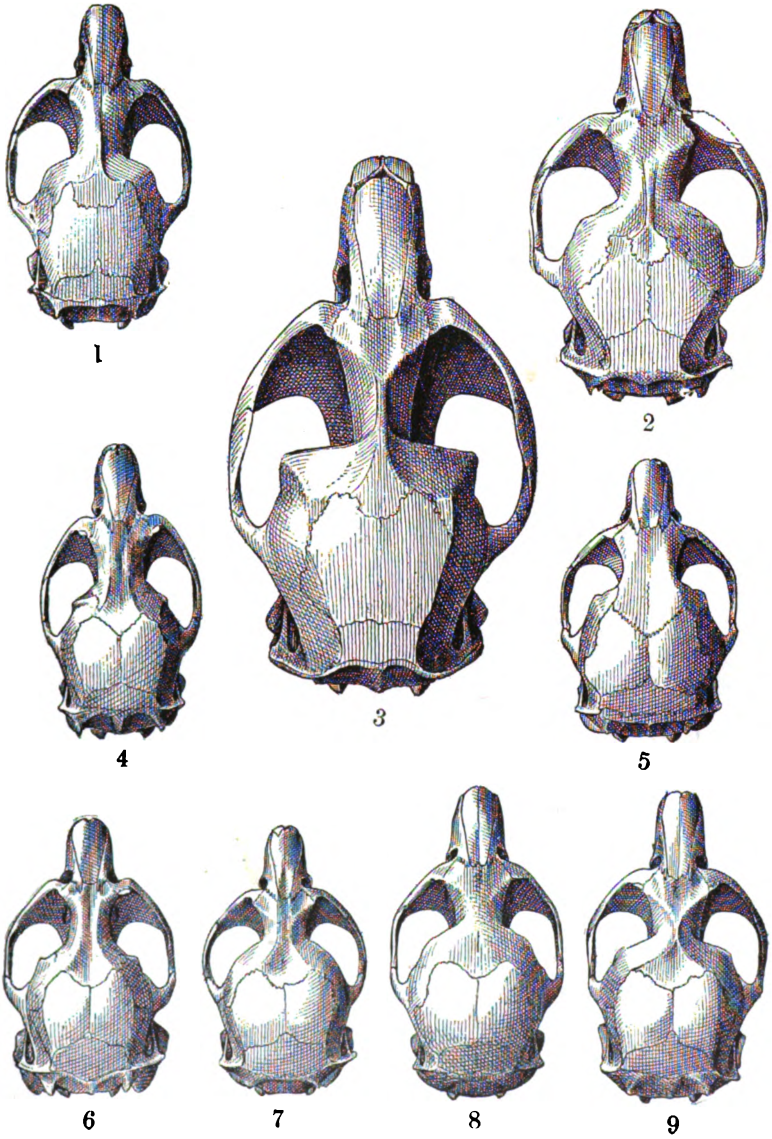
PLATE III.

Skulls of 9 subgenera, lower view.

[Enlarged one and one-half times.]

FIG. 1. *Microtus* (*Microtus*) *pennsylvanicus*. Hyattsville, Md.
(No. 87163, ♀ ad., U. S. Nat. Mus.)
2. *Microtus* (*Arricola*) *macropus*. Sawtooth Lake, Idaho.
(No. 31451, ♀ ad., U. S. Nat. Mus.)
3. *Microtus* (*Neofiber*) *alleni*. Eden, Fla.
(No. 24112, ♀ ad., U. S. Nat. Mus.)
4. *Microtus* (*Pedomys*) *austerus*. Racine, Wis.
(No. 92851, ♂ ad., U. S. Nat. Mus.)
5. *Microtus* (*Pitymys*) *pinetorum*. Frogmore, S. C.
(No. 1523, ♂ ad., Merriam Collection.)
6. *Microtus* (*Lagurus*) *curtatus*. Mount Magruder, Nev.
(No. 41017, ♂ ad., U. S. Nat. Mus.)
7. *Microtus* (*Chilotus*) *oregoni*. Astoria, Oreg.
(No. 24255, ♂ ad., U. S. Nat. Mus.)
8. *Microtus* (*Orthriomys*) *umbrosus*. Mt. Zempoaltepec, Oaxaca, Mexico.
(No. 68469, ♀ ad., U. S. Nat. Mus.)
9. *Microtus* (*Herpetomys*) *guatemalensis*. Todos Santos, Guatemala.
(No. 76776, ♂ ad., U. S. Nat. Mus.)

PLATE II.



SKULLS OF REPRESENTATIVE SPECIES OF THE NINE SUBGENERA OF *Microtus* (top view).

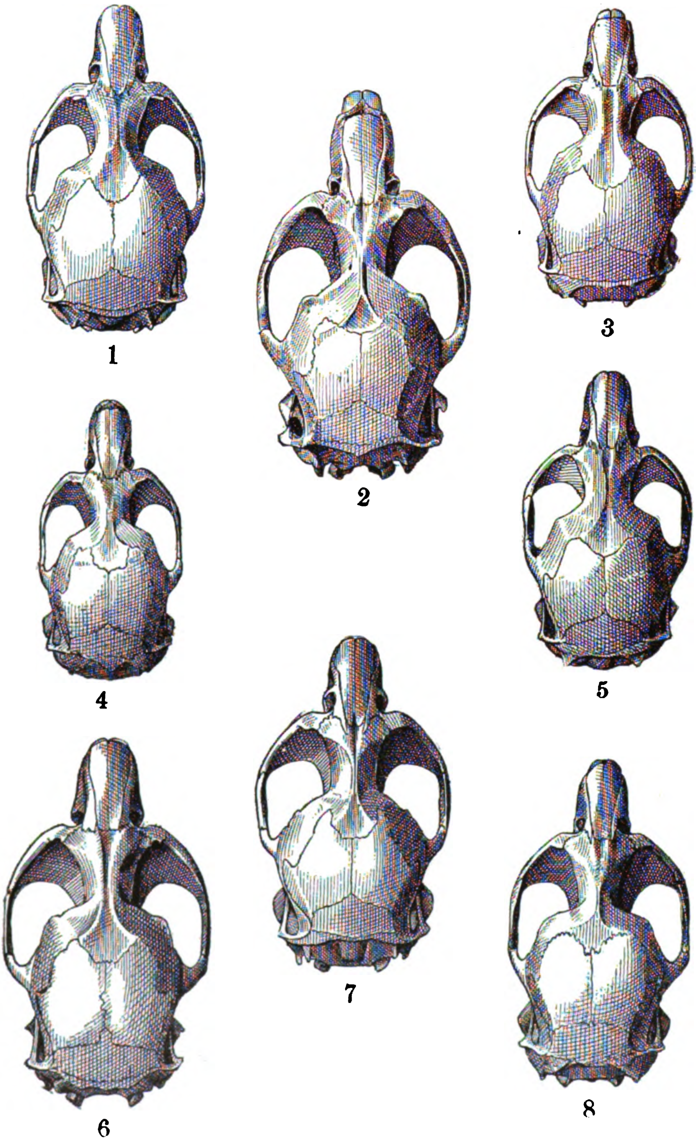
1. *Microtus* (*Microtus*) *pennsylvanicus*.
2. *Microtus* (*Arvicola*) *macropus*.
3. *Microtus* (*Neofiber*) *alleni*.
4. *Microtus* (*Pedomys*) *austerus*.
5. *Microtus* (*Pitymys*) *pinetorum*.
6. *Microtus* (*Lagurus*) *curtatus*.
7. *Microtus* (*Chilotus*) *oregoni*.
8. *Microtus* (*Orthriomys*) *umbrosus*.
9. *Microtus* (*Herpetomys*) *guatemalensis*.

PLATE V.

Skulls of 7 groups in subgenus *Microtus*, lower view.

[Enlarged one and one-half times.]

FIG. 1. *Microtus mordax*. Red Lodge, Mont.
(No. 67305, ♀ ad., U. S. Nat. Mus.)
2. *Microtus nevadensis*. Ash Meadows, Nev.
(No. 39663, ♂ ad., U. S. Nat. Mus.)
3. *Microtus nanus*. Sawtooth Lake, Idaho.
(No. 75181, ♂ ad., U. S. Nat. Mus.)
4. *Microtus operarius*. St. Michael, Alaska.
(No. 22214, ♂ ad., U. S. Nat. Mus.)
5. *Microtus chrotorrhinus*. Mount Washington, N. H.
(No. 1501, ♂ ad., Bangs Collection.)
6. *Microtus townsendi*. Steilacoom, Wash.
(No. 42921, ♂ ad., U. S. Nat. Mus.)
7. *Microtus californicus*. Walnut Creek, Cal.
(No. 44678, ♂ ad., U. S. Nat. Mus.)
8. *Microtus mexicanus*. Orizaba, Puebla, Mexico.
(No. 53406, ♀ ad., U. S. Nat. Mus.)



SKULLS OF REPRESENTATIVE SPECIES OF SEVEN OF THE GROUPS IN THE SUBGENUS *Microtus* (top view).

1. *Microtus mordax.*
2. *Microtus nevadensis.*
3. *Microtus nanus.*
4. *Microtus operarius.*
5. *Microtus chrotorrhinus.*
6. *Microtus townsendi.*
7. *Microtus californicus.*
8. *Microtus mexicanus.*

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U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 19

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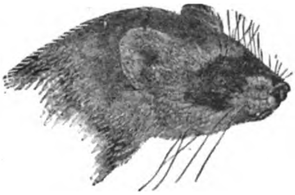

RESULTS OF A BIOLOGICAL RECONNOISSANCE OF THE YUKON RIVER REGION

General Account of the Region
Annotated List of Mammals
By Wilfred H. Osgood

Annotated List of Birds
By Louis B. Bishop, M. D.

Prepared under the direction of
Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1900

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Washington, D. C., *July 28, 1900.*

Sir: I have the honor to transmit for publication, as No. 19 of North American Fauna, a report entitled 'Results of a Biological Reconnoissance of the Yukon River Region,' by Wilfred H. Osgood and Louis B. Bishop.

Under instructions dated May 11, 1899, Wilfred H. Osgood, an assistant in the Biological Survey, proceeded to Skagway, Alaska, and thence over White Pass to the headwaters of the Yukon and down the entire length of the Yukon River to St. Michael. He was accompanied by Dr. Louis B. Bishop, of New Haven, as volunteer assistant; Dr. Bishop has prepared the report on the birds observed during the trip. These are the first investigations of the kind undertaken on the Upper Yukon, and the results herewith presented will be found to contain many important facts concerning the distribution of mammals, birds, and trees in this region.

Respectfully,

C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

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No. 19. NORTH AMERICAN FAUNA. October, 1900.

RESULTS OF A BIOLOGICAL RECONNOISSANCE OF THE YUKON RIVER REGION.

GENERAL ACCOUNT OF THE REGION.

By Wilfred H. Osgood.

Nowhere else in North America is such a vast extent of boreal country so easily accessible as along the Yukon. The navigable waters of the river begin at Lake Bennett, only 35 miles from the port of Skagway, on the coast of southeast Alaska, and with but one short interruption, extend northward as far as the Arctic Circle and then westward to Bering Sea; in all, a distance of more than 1,800 miles. The recent developments resulting from the discovery of gold in this region include a modern railroad from Skagway to Bennett and a tram-car service around the dangerous White Horse Rapids. The chief obstacles to ready access to the territory have thus been removed, and an opportunity is afforded for obtaining specimens and information from a region much of which was previously unknown to naturalists. Accordingly, with Dr. Louis B. Bishop as voluntary companion and A. G. Maddren as assistant, I was detailed to make a hasty biological reconnoissance of this region during the summer of 1899.

ITINERARY.

After outfitting at Seattle, Wash., we sailed via the Inside Passage direct to Skagway, Alaska, where we arrived on May 30. From Skagway we worked slowly over White Pass and down to Lake Bennett, at the head of navigation on the Yukon. Here we embarked in a small flat-bottomed boat suited to our needs and sailed down the series of lakes that follow one another for nearly 200 miles. From the lakes we passed into Thirty-Mile River, thence into Lewes River, and finally into the Yukon proper, stopping frequently and making collections at favorable points. With the aid of the swift, even current we were able to make easy and rapid progress. Thus we continued until an unfortunate capsize between Fort Yukon and Fort Hamlin prevented further detailed work on the river, and we were obliged to proceed direct to St. Michael, where a month was spent in collecting on the coast and tundra. Finally, late in September, our work was brought to a close by the approach of the long arctic winter. We returned to Seattle on the U. S. revenue cutter *Corwin*, which stopped on her way for a few hours at St. George Island and at Unalaska, at each of which places we collected a few birds.

A relatively large part of our time was spent in the White Pass region and about the headwaters of the Yukon, as this was an absolutely virgin field, whereas part of the lower river had been previously visited by naturalists. We were unable to do any collecting in the mountains which lie back from the river, owing to the great distance to be covered and the shortness of the season. Legions of mosquitoes were attendant upon us almost constantly. At first they seemed positively unbearable and were a real hindrance to the work, but we gradually became accustomed to them, and by the use of gloves, head nets, and canopies to sleep under, managed to exist in comparative comfort. Aside from insect pests, however, outdoor life on the Yukon in June and July is very enjoyable; good camping places are abundant, and the weather is mild and beautiful. During the latter part of August and in September strong winds sweep up the river and frequent rains occur.

FAUNAL DISTRICTS.

The country traversed may be divided for convenience into five districts: (1) The Lynn Canal district, (2) the White Pass district, (3) the Canadian Yukon district, (4) the Hudsonian Yukon district, and (5) the Alaska Tundra district. These districts are limited in a general way by their respective life zones, but they are not of equal extent or importance, and the names applied to them are used not to specially designate restricted parts of zones already recognized, but purely as a matter of convenience. They are longitudinal districts—that is, they are very much longer than wide, and each is merely a narrow tract covered by our route through some larger faunal region.

Lynn Canal district.—Skagway and the country bordering Lynn Canal are in the northern part of that faunal area which Nelson has called the 'Sitkan district' and which has often been included in the Northwest Coast district. The trees and shrubs are much the same as those at Juneau, Wrangell, and other points farther south, but the vegetation is not quite so dense and luxuriant. The shores of Lynn Canal are steep, rocky, and comparatively sparsely timbered, but in some places, as at Haines, low, swampy ground and heavy saturated forests are found. At Skagway, poplars (*Populus tremuloides* and *Populus* *balsamifera*) are very common; they share the river bottom with willows and extend well up the steep canyon sides, where they occupy large areas adjacent to the pines, firs, and spruces. Skagway is surrounded by high mountains, and its fauna is limited chiefly by altitude. Glacier Station, 14 miles distant, and about 1,900 feet higher, is near the boundary between the Lynn Canal and White Pass districts. The station is situated on the side of a wooded gulch through which a fork of Skagway River flows. The immediate vicinity is similar to the country about Skagway, but shows the influence of the Hudsonian zone of the White Pass district, which begins only a short distance beyond. On either side of the gulch are glaciated granite cliffs supporting an irregularly distributed vegetation, chiefly groves of poplars and dense thickets of alders, while in the bottom of the gulch conifers are the prevailing trees. The most common trees and shrubs are lodgepole pines (*Pinus murrayana*), alpine firs (*Abies lasiocarpa*), tidewater spruces (*Picea sitchensis*), poplars or aspens (*Populus tremuloides* and *Populus balsamifera*), alders (*Alnus sinuata*), dwarf birches (*Betula glandulosa*), currants (*Ribes laxiflorum*), and huckleberries (*Vaccinium ovalifolium*). The black crowberry (*Empetrum nigrum*) and several other heather-like plants occur in the gulch but are more common higher up. Along the trickling streams are many ferns and mosses, as well as occasional patches of the lichen known as 'reindeer moss.' Among the mammals of this region are the Streator shrew (*Sorex p. streatori*), the Bangs white-footed mouse (*Peromyscus oreas*), the Dawson red-backed mouse (*Evotomys dawsoni*), the long-tailed vole (*Microtus mordax*), and the red squirrel (*Sciurus h. petulans*). Characteristic birds are the sooty song sparrow (*Melospiza m. rufina*), the Townsend fox sparrow (*Passerella i. townsendi*), the Oregon snowbird (*Junco h. oregonus*), and the varied thrush (*Hesperocichla nævia*).

White Pass district.—The summits of the mountains that rise directly east of Skagway are covered with glaciers and perpetual snow, which feed numerous streams that flow down between massive walls of granite. The sides of the wider canyons have been smoothed and scored by glaciation, and the smaller and more recent ones are but jagged rock-bound chasms. These unfavorable conditions cause a rapid change in the character of the plant and animal life, and from Glacier to the summit of White Pass the zones are Hudsonian and Arctic-alpine. A few hundred feet above Glacier the trees become smaller and more scattered, and at Summit only the alpine juniper (*Juniperus nana*), the bearberry (*Arctostaphylos uvaursi*), and depauperate alpine hemlocks (*Tsuga mertensiana*) occur. Heathers and mosses prevail and large areas of reindeer moss are conspicuous. For some distance on the summit of White Pass (Plate II, fig. 1) the elevation and physiography are much the same; the country is slightly rolling and consists entirely of granite rock, about which cling many mosses and heathers, while small alpine junipers and hemlocks struggle for existence in favorable places. The breeding birds found with these Hudsonian plants were ptarmigan (*Lagopus rupestris* and *L. leucurus*), pipits (*Anthus pensilvanicus*), rosy finches (*Leucosticte t. littoralis*), and golden-crowned sparrows (*Zonotrichia coronata*). Characteristic mammals noted were pikas (*Ochotona collaris*), hoary marmots (*Arctomys caligatus*), and mountain goats (*Oreamnos montanus*).

Canadian Yukon district.—Lake subdivision: On the north side of the divide the hemlocks are soon replaced by pines and spruces, and in the vicinity of Shallow Lake the boundary of the interior fauna and flora is reached. The change is complete at Log Cabin, British Columbia, nine miles from the head of Lake Bennett, where the characteristic features of the Canadian zone are again established and the general aspect of the country is very different. The most abundant tree is the white spruce (*Picea canadensis*), and among shrubs seen for the first time the buffalo berry (*Lepargyræa canadensis*) is very common. Birds marking a change of fauna are the slate-colored junco (*Junco hyemalis*), the Alaska jay (*Perisoreus canadensis fumifrons*), the intermediate sparrow (*Zonotrichia l. gambeli*), and the black-poll warbler (*Dendroica striata*). A new chipmunk (*Eutamias caniceps*) is very conspicuous. At the head of Lake Bennett another change occurs; the country becomes more arid and rocky and there is a tinge of Hudsonian.

Lake Bennett is a long, narrow sheet of water inclosed by high granite cliffs, the sides of which are often so steep as to be unfavorable for plant and animal life, and whose summits are doubtless similar to White Pass in fauna and flora. Cold winds sweep down the lake much of the time, and cool shadows envelop the east side most of the forenoon and the west side most of the afternoon, so that opportunity for warmth by direct sunlight is limited. Hence there is quite a strong Hudsonian element about the lake. Among the plants[1] collected here are the pale dwarf laurel (*Kalmia glauca*), the Greek valerian (*Polemonium humile*), the forget-me-not (*Myosotis sylvatica alpestris*), the alpine juniper (*Juniperus nana*), the bush cranberry (*Viburnum pauciflorum*), the dwarf birch (*Betula glandulosa*), the bearberry (*Arctostaphylos uvaursi*), the buffalo berry (*Lepargyræa canadensis*), the shadbush (*Amelanchier alnifolia*), the Labrador tea (*Ledum grœnlandicum*), and the black crowberry (*Empetrum nigrum*). Where trickling streams come down to the lake alder thickets abound, and along terraces of rock clumps of pines and spruces as well as poplars find support. Among Hudsonian mammals were found pikas (*Ochotona collaris*), hoary marmots (*Arctomys caligatus*), and Dall sheep

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[1] Identified by F. V. Coville, chief botanist, U. S. Department of Agriculture.

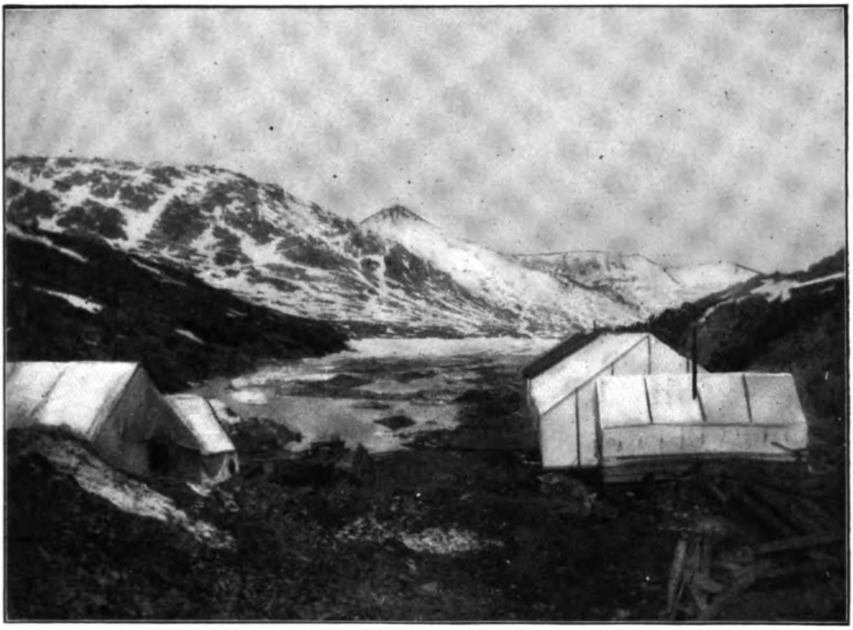

FIG. 1.—SUMMIT OF WHITE PASS.

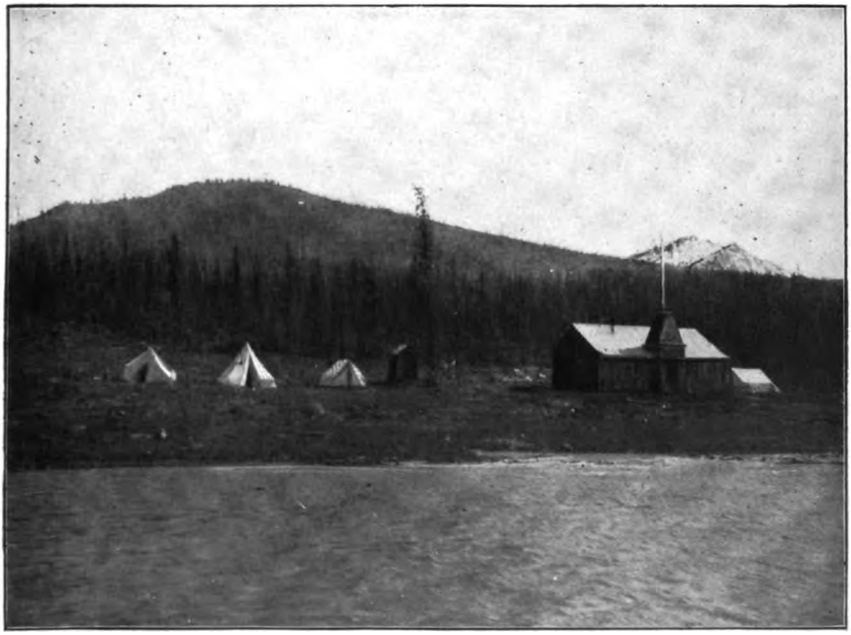

FIG. 2.—CANADIAN POLICE STATION AT CARIBOU CROSSING.

(*Ovis dalli*). Although the lake widens slightly at its lower end, its outlet is a narrow stream about 2 miles long, called Caribou Crossing (Plate II, fig. 2), on the north side of which is an open, grassy swamp bordered by willow thickets. This low country, though very limited and not extending to the next lake, affords a breeding place for a few mammals and birds not found about Bennett.

Lake Tagish, which receives the waters of Bennett through Caribou Crossing, is like Bennett in character, though not so closely walled, and is characterized by practically the same plants and animals. The surrounding mountains are covered with dense forests, which in many places are almost impenetrable.

Connected with Lake Tagish by a short, narrow stream, known as Six-Mile River, is Lake Marsh, a long shallow lake on each side of which extends low country, with rolling hills farther back. The valley widens here quite appreciably, and the open country is like that at Caribou Crossing. On the east side are sedgy bogs surrounded by willow thickets, and in many places a wide margin of beautiful green sedge meets the edge of the water. Rocky shores are found at some points on the northwest side, but in general the country is low and moist, in marked contrast to that about Bennett and Tagish. The mountain animals of those lakes are of course absent, and the bird life is also somewhat different.

Fifty-Mile River, into which the Yukon waters proceed from Lake Marsh, is rather narrow, and for a short distance at White Horse Rapids very swift. Its banks are chiefly abrupt bluffs of sandy clay (from 50 to 100 feet high) but at Miles Canyon it is confined between walls of basalt. Below the rapids the stream widens somewhat and the high banks become less frequent, often being replaced by low ones thickly grown with willows. The timber is somewhat scattered, and on the rolling hills back from the river bare granite spaces may be frequently seen. At the head of Fifty-Mile River, we first met with birch trees (*Betula papyrifera ?*), and from that time on they were seen daily. They do not grow to large size—trees more than 8 inches in diameter were seldom seen. Several small streams flow into Fifty-Mile River, which favor the growth of thickets of alders along their banks and large clumps of willows about their mouths. The little boreal sagebrush (*Artemisia frigida*) grows abundantly on the warm exposed slopes that occasionally alternate with the sandy bluffs. Lodgepole pines are also abundant and frequently occupy large areas to the exclusion of all other trees. Spruce and poplar, however, are still the strongest elements in the forest.

From Fifty-Mile River we enter Lake Lebarge, the last and largest of the lakes. All about its clear, cold waters are low granite mountains (Plate III, fig. 1). Occasionally patches of heavy spruce forest are found near the water, but in many places cliffs rise abruptly from the water's edge, and the timber is very sparsely sprinkled over them. The rocks found here and a few in Thirty-Mile River are the last we saw showing signs of glaciation. Lake Lebarge is quite different from Lake Marsh, and is more similar to Lakes Tagish and Bennett, though all the Hudsonian elements of these are not present.

River subdivision: This area includes the section from the foot of Lake Lebarge to the mouth of the Pelly River at Fort Selkirk. There is very little variety in the character of the country between these points. Thirty-Mile River, which proceeds from Lake Lebarge, is a swift, narrow stream, and at low water is barely navigable for small steamers. A conspicuous feature of its banks, which are cut abruptly like those of Fifty-Mile River, is a narrow ribbon-like stratum of volcanic ash about 6 inches below the surface that may be seen wherever the bank is exposed. On the mountains a short distance from the river the forest of spruce is heavier and purer than any previously noted. The poplars and willows are more confined to the brink of the river, and the birches are scattered. Thirty-Mile River is simply that portion of the Yukon between Lake Lebarge and the mouth of the Hootalinqua or Teslin River. The stream is greatly augmented by the waters of the Hootalinqua, and from this point on to Fort Selkirk is known as the Lewes River. Below the Hootalinqua it cuts through the Semenow Hills, for the most part abrupt, rocky, and rather barren mountains from 2,000 to 3,000 feet high. Near their bases and at the water's edge are forested areas, but the exposed hillsides are covered with boreal sagebrush (*Artemisia frigida*), with here and there a prostrate juniper or a small clump of spruces. The river now widens rapidly, receiving in succession the waters of the Big Salmon, the Little Salmon, and the Nordenskiold. The rolling hills are sometimes a mile or several miles from the river bank, with low willow swamps intervening. Islands varying from 1 to 100 acres in extent and covered with luxuriant vegetation are abundant. The distribution of trees on the small, regular-shaped islands is very uniform, the different kinds being grouped in concentric belts. Alders generally form the outer margin; next come the willows; next the poplars, rising somewhat higher; and finally the dark-green spruces, which occupy the central area. The whole effect is quite picturesque. On the larger islands the spruces are larger, and usually predominate to such an extent that almost everything else should be classed as undergrowth (including trees and shrubs belonging to the genera *Alnus*, *Salix*, *Populus*, *Lepargyræa*, *Cornus*, *Viburnum*, *Rosa*, *Ledum*, *Vaccinium*, *Ribes*, and others). Lodgepole pines still occur, though unlike the spruces they nowhere form continuous forest and disappear entirely a short distance beyond Fort Selkirk.

The Canadian Yukon district as a whole is very well marked. Characteristic mammals are the gray-headed chipmunk (*Eutamias caniceps*),

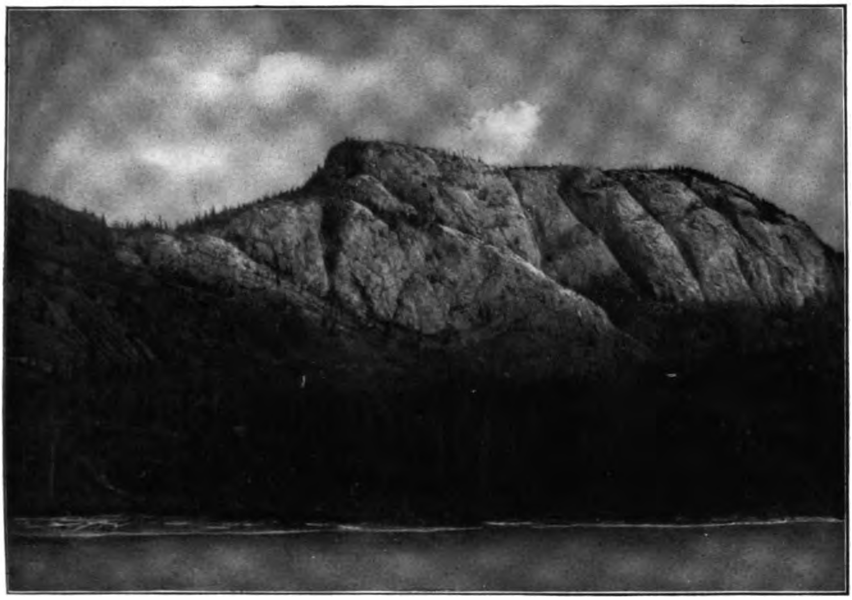

FIG. 1.—CLIFFS ON EAST SIDE OF LAKE LEBARGE.

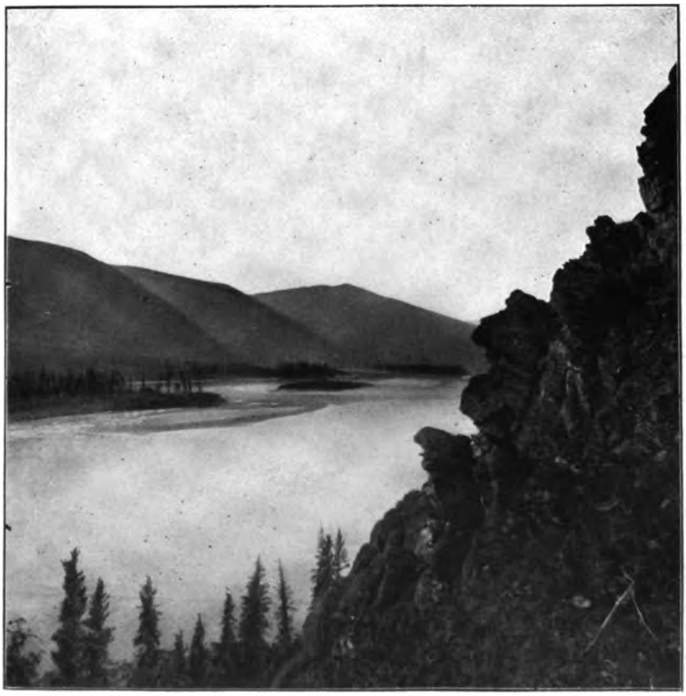

FIG. 2.—YUKON RIVER, 50 MILES BELOW FORT SELKIRK.

the Bennett ground squirrel (*Spermophilus empetra plesius*), the Northern bushy-tailed rat (*Neotoma saxamans*), white-footed mice (*Peromyscus oreas* and *Peromyscus maniculatus arcticus*), and the varying hare (*Lepus saliens*). All of these species and three of the genera, *Eutamias*, *Neotoma*, and *Peromyscus*, find their northern limits in this district. Among birds that are known from the Yukon only in this district may be mentioned the sparrow hawk (*Falco sparverius*), the screech owl (*Megascops asio kennicottii?*), the night hawk (*Chordeiles virginianus*), the tree swallow (*Tachycineta bicolor*), the Tennessee warbler (*Helminthophila peregrina*), the pileolated warbler (*Wilsonia pusilla pileolata*), and the mountain bluebird (*Sialia arctica*). Of these, *Chordeiles* is perhaps the most noteworthy, as it is decidedly a southern genus. It is very common, and was seen nightly from Caribou Crossing to Rink Rapids, but after we had passed that point it disappeared. Its range in this region as observed by us is probably accurate and corresponds with the limits of the district. Among trees, the lodgepole pine (*Pinus murrayana*) is common throughout the district, but does not extend beyond it.

Hudsonian Yukon district.—This district, as here considered, includes all of the Yukon region from Fort Selkirk to the limit of trees. The Lewes River is joined at Fort Selkirk by the Pelly, after which the increased volume of water flows on between heavily forested slopes and jutting cliffs (Plate III, fig. 2), which replace the sandy banks of the upper river. From the mouth of the Selwyn northward the topography of the river banks is but slightly different. The number of poplars in the forest is much increased; the spruces are correspondingly decreased not only in number but also in size; while the birches about hold their own, and the pines are not present at all, having disappeared between Fort Selkirk and the mouth of the Selwyn River. As we approach Dawson spruces become dwarfed and entirely subordinate to the poplars, which crowd their bushy tops together for miles and miles. The spruces are in the gulches and in small clumps elsewhere, and a few are scattered about, their dark-green spike tops showing off well against the billowy mass of the lighter foliage of poplar and birch. The undergrowth remains much the same, and deep moss covers the ground and rocks. In damp sandy places along shore and on islands occasionally overflowed a bright-green scouring rush (*Equisetum*) grows so abundantly as to be a characteristic plant. The alpine juniper (*Juniperus nana*) is found occasionally on hillsides not too thickly grown with poplars, and on the more open hillsides the landscape is brightened by masses of fireweed (*Chamænerion angustifolium*), for even here forest fires are not a novelty.

Two more large rivers, the White and the Stewart, empty into the Yukon in this vicinity. About the mouths of these and other tributaries is more or less low country covered with willows. Islands become still more numerous and larger, and have a forest growth that is more uniform in character than that of the river banks. High cliffs overhanging the river are of frequent occurrence.

From Dawson to the Alaska boundary and thence to Circle the country is about the same. For a long distance in the vicinity of the boundary a range of high mountains is visible to the northward on the right bank of the river. The low, rolling hills which border the upper river do not quite reach Circle, but are replaced by a broad, flat country known as the 'Yukon Flats,' which extends from near Circle to Fort Hamlin, a distance of about 200 miles. Through the 'Flats' the course of the river breaks up into a great many channels, and the islands still further increase in size and number. These are composed of sand and silt, in which poplars thrive better than spruces, though the latter are by no means eliminated. A wild rose (*Rosa cinnamomea?*) is the most abundant shrubby plant, and on the ground below it the *Equisetum* is rampant. The larger islands are identical in character with the mainland, and on them the spruces form quite a heavy forest, with deep moss beneath. At Fort Hamlin the river narrows again and flows between rolling wooded hills, which are similar to many farther up the river. Small streams enter the main river frequently, and the timber is much the same; poplars, alders, and birches cover the hills in dense thickets, through which spruces are sprinkled. Alders are more numerous than before. The hills vary in height from 500 to 3,000 feet, and the highest have a distinct timberline at about 2,000 feet. At the mouth of the Tanana the hills become smaller and the river very much wider. Here, at Fort Gibbon, Dr. Bishop found the larch (*Larix americana*) quite abundant. This was the only point at which it was seen by any of our party.

The Lower Yukon beyond the Tanana is very uniform in character. The banks are low and rolling and overgrown with willows and alders; farther back are higher hills covered with poplars and birch; occasionally the summits of a few hills higher than the rest are devoid of trees. On the sandy islands the willow thickets are impenetrable, and where a cut bank exposes a section of them their slender perpendicular trunks stand so closely as to present a solid front like a thick hedge or canebrake. Thus it continues until the limit of timber is reached at Andraefski, 90 miles above the mouth of the Yukon.

This district as a whole is characterized by absence of southern plants and animals. Among migratory birds a few have their center of abundance farther south, but all the mammals are northern forms, and nearly all belong to genera of circumpolar distribution.[1] Plant life, though quite luxuriant, is made up of only a small number of hardy species. Characteristic mammals are the Fort Yukon ground squirrel (*Spermophilus osgoodi*), Dawson red-backed mouse (*Evotomys dawsoni*), yellow-cheeked vole (*Microtus xanthognathus*), Yukon lemming (*Lemmus yukonensis*), Dall varying hare (*Lepus americanus dalli*), and tundra weasel (*Putorius arcticus*). Of the birds, the most characteristic are the duck hawk (*Falco peregrinus anatum*), pigeon hawk (*Falco columbarius*), Alaska longspur (*Calcarius lapponicus alascensis*), hoary redpoll (*Acanthis hornemanni exilipes*), fox sparrow (*Passerella iliaca*), Bohemian waxwing (*Ampelis garrulus*), and wheatear (*Saxicola œnanthe*).

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[1] The only exceptions are *Synaptomys*, *Fiber*, and *Erethizon*.

Alaska Tundra district.—The Yukon from Andraefski to the coast of Norton Sound is bounded on both sides by typical tundra. The country is low and gently undulating, and its surface a short distance away appears to be thickly carpeted with grass. That this is not the real condition a short walk ashore soon demonstrates; but the delusion is so complete that were it not for the presence of the great river one might fancy himself looking out over the undulating plains at the eastern base of the Rocky Mountains in the western United States.

The flora of the tundra, though devoid of trees deserving of the name, is found on careful examination to be quite varied. Besides the numerous mosses and heathers and many small berry-bearing plants are dwarf willows, birches, and alders. The alders attain the greatest size, but are usually found in isolated clumps in favorable spots, where they often grow from 6 to 8 feet high. The ground is frozen a few inches below the surface, and the heavy, spongelike covering of vegetation is kept constantly saturated. Occasional high bluffs on the coast in exposed situations are bleak and bare, but besides these there is scarcely a spot not covered with low, matted vegetation. Numerous small ponds are irregularly distributed over the tundra, and around them the vegetation is ranker than elsewhere. Broken lava borders the shores of St. Michael Island, and small moss-covered heaps of it, which form practically the only solid footing on the island, are scattered about over the tundra.

Characteristic mammals at St. Michael are the Hall Island fox (*Vulpes hallensis*), Nelson vole (*Microtus operarius*), tundra red-backed mouse (*Evotomys dawsoni alascensis*), Nelson pied lemming (*Dicrostonyx nelsoni*), Alaska lemming (*Lemmus alascensis*), and Alaska Arctic hare (*Lepus othus*). Land birds known to breed are the hoary redpoll (*Acanthis hornemanni exilipes*), common redpoll (*Acanthis linaria*), Alaska longspur (*Calcarius lapponicus alascensis*), western tree sparrow (*Spizella monticola ochracea*), golden-crowned sparrow (*Zonotrichia coronata*), and Siberian yellow wagtail (*Budytes flavus leucostriatus*). Common tundra plants[1] are *Cassiopea tetragona*, *Andromeda polifolia*, *Vaccinium vitisidæa*, *Mairania alpina*, *Ledum palustre*, *Artemisia*

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[1] Nelson, Report upon Natural History Collections in Alaska, 30, 1887.

arctica, *Rubus chamæmorus*, *Rubus arcticus*, *Betula nana*, *Alnus sinuata*, *Chamæcistus procumbens*, and *Tussilago frigida*.

SUMMARY OF FAUNAL DISTRICTS.

All the country here considered is in the boreal zones, the Tundra district and a small part of the White Pass district belonging to the Arctic subdivison, and the Yukon Valley principally to the Hudsonian, though it has also a well-marked Canadian section. Birds are comparatively rare in all the interior region, and it is difficult to determine the exact range of many species. Some were seen but once or twice; others appeared sporadically at rather long intervals; while still others that are known from the region were not seen at all; so it is hardly safe, in making generalizations, to rely too much on the ranges observed by us. The distribution of trees and shrubby plants and of many of the mammals, however, could be determined with much greater accuracy and constitute reliable guides in fixing the limits of the districts. These districts are in general the same as those recognized by Nelson, but with more definite and somewhat modified limits. Names slightly different from those he used are adopted here in order to agree with the commonly accepted names of the primary zones of North America. Thus the part of his 'Alaskan-Canadian' district here considered is called the 'Hudsonian Yukon' district, since it lies entirely within the transcontinental Hudsonian zone. Owing to fluviatile conditions, the boundaries of the Yukon districts doubtless do not agree in latitude with those which might be made away from the rivers.

The zones which we successively traversed in going from Skagway to St. Michael via White Pass and the Yukon are: (1) Canadian; (2) Hudsonian; (3) Arctic-Alpine; (4) Canadian; (5) Hudsonian, and (6) Arctic. The Lynn Canal district is in the Canadian zone, but it has some slight peculiarities such as are to be expected in a coast district. Though it does not have the Hudsonian animals of the northern coast, it lacks several of the typical Canadian forms of the coast farther south.[1] It is really near the northern limit of the Canadian zone on the Pacific coast. The occurrence at Skagway of mammals of the interior, such as *Microtus mordax*,[1] *Evotomys dawsoni*, and *Peromyscus oreas*, seems to show an approach to the condition farther north where the coast and interior forms are practically the same. The Canadian zone of the Lynn Canal district gives way to the Hudsonian and Arctic-Alpine in the White Pass district. The character of this district is essentially the same as that of other mountain regions in western North America. This is well indicated by the fact that its mammals include the hoary marmot (*Arctomys caligatus*), the Alaska pika (*Ochotona collaris*), and the mountain goat (*Oreamnos montanus*), and its birds the ptarmigan (*Lagopus leucurus* and *L. rupestris*), the pipit (*Anthus pensilvanicus*), and the rosy finch (*Leucosticte t. littoralis*).

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[1] The coast of Alaska south of the peninsula, or what has been known as the 'Sitkan district,' may be easily divided into two districts corresponding to the Canadian and Hudsonian zones. Lynn Canal is situated near the boundary between these districts. Among Canadian mammals which have their center of abundance in the restricted Sitkan district on the coast south of Lynn Canal are: *Odocoileus sitkensis*, *Sciurus vancouverensis*, *Peromyscus macrorhinus*, *Evotomys wrangeli*, *Microtus macrurus*, *Synaptomys wrangeli*, *Zapus saltator*, and *Myotis alascensis*. Among the Hudsonian forms found on the coast only north of Lynn Canal are: *Rangifer* sp., *Ovis dalli*, *Sciurus hudsonicus*, *Spermophilus e. plesius*, *Zapus h. alascensis*, *Ochotona collaris*, and *Myotis lucifugus*. Among trees which find their northern limit in the vicinity of Lynn Canal are: *Thuja plicata*, *Abies lasiocarpa*, and *Pinus murrayana*. The northern district from Lynn Canal to Kadiak is so similar to the great interior Hudsonian region that it hardly merits recognition as a distinct district, but it certainly should not be included in the Sitkan district.

The Canadian Yukon district from Bennett to Fort Selkirk merely represents the extent to which our route entered the extreme northern part of the Canadian zone; that is, its limits are those of the section that our route made across the end of a narrow tongue which extends northward from the great areas occupied by the Canadian zone farther south. Owing to its being so near the border of the Hudsonian zone, its character is not purely Canadian, but the presence of such forms as chipmunks (*Eutamias*) and white-footed mice (*Peromyscus*) among mammals, night hawks (*Chordeiles*) among birds, and lodgepole pines (*Pinus murrayana*) among trees, makes it evident that the Canadian element is very strong. The Hudsonian Yukon district represents the complete section which the Yukon River makes through the great northern forest belt of the Hudsonian zone. This belt corresponds to the Alaskan-Canadian district outlined by Nelson. It is bounded on the south by the Canadian zone and the extreme northern limit of southern forms, and on the north by the treeless tundra. On the west it probably reaches and includes the coast from Kadiak to Lynn Canal; on the east its limits are unknown. The Alaska Tundra district defines itself. Its character is the combined result of latitude and rigorous coast climate. Our experience in this treeless district was limited to St. Michael Island and the ninety miles between Andraefski and the mouth of the Yukon. The animals of this region are not all absolutely confined to it, many of them ranging some distance into the forest belt. Small mammals, such as the Nelson vole (*Microtus operarius*), occupy so-called 'islands'—local spots offering what are practically tundra conditions—as far within the forest belt as Circle.

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[1] The case of *Microtus mordax* at the head of Lynn Canal is particularly interesting, since a closely related form, *M. macrurus*, has been found at Glacier Bay on the north side of the mouth of the canal and also at Juneau on the south side, and would therefore be expected at Skagway, which is halfway between. Assuming that *macrurus* has been dispersed from the south northward on the coast, it seems that it did not reach Glacier Bay by way of the present mainland, otherwise it would be found at Skagway. *M. mordax* doubtless reached Skagway from the interior.

The fauna of the Yukon basin as a whole is composed of two principal elements, one containing absolutely circumpolar forms, evidently derived from the north, the other containing forms which have their center of abundance farther south. This is particularly true of the mammals. Among the genera belonging to the north may be mentioned *Rangifer*, *Evotomys*, *Lemmus*, and *Dicrostonyx*, all of which are circumpolar in distribution; those from farther south are *Alces*, *Sciuropterus*, *Eutamias*, *Peromyscus*, *Neotoma*, *Fiber*, and *Synaptomys*. With the exception of alpine species and a few wide-ranging forms, chiefly carnivores, the variations of which are not sufficiently known to be of use in defining faunal regions, no species of mammals are common to the Yukon region and the Sitkan coast district. From this it seems that all the southern forms which reach the Yukon region have been derived from the interior rather than from the coast. This is also true of the trees and to a great degree of the birds. But, on the other hand, some species of land birds are common to the lower Yukon and the Sitkan district while a large intervening area in the interior is uninhabited by them.[1] *Selasphorus rufus*, *Dendroica townsendi*, and *Hylocichla aonalaschkæ* were found on both sides of White Pass, but only rarely and for a very short distance on the interior side.

PREVIOUS WORK.

Our knowledge of the natural history of the Yukon region has been derived chiefly from two sources—the members of the Russo-American Telegraph Expedition and the Signal Service officers formerly stationed at St. Michael. The first information was gathered by the scientific corps of the Telegraph Expedition of 1865 to 1868. Prominent among the members of this corps were Robert Kennicott, William H. Dall, and J. T. Rothrock; all of whom secured valuable specimens and information. The notes of Kennicott were not published, owing to his untimely death at Nulato, May 13, 1866, but numerous specimens, particularly from the vicinity of Fort Yukon, are now in the National Museum, a monument to his faithful pioneer work. Among the numerous papers on various subjects relating to Alaska published by Dall are lists of birds and mammals.[2] A list of plants including some records from Fort Yukon was published by Rothrock.[3]

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[1] One of these species is the varied thrush (*Hesperocichla nævia*) which was found in the Lynn Canal district, but not in any numbers in the Yukon Valley above Dawson. Below Dawson it is quite common along the Yukon and undoubtedly breeds there. It is well known to range along the Pacific coast to Kadiak, and thence to the shores of Kotzebue Sound and up the Kowak River. Its absence on the Upper Yukon and its occurrence all along the coast make it extremely probable that in reaching the Yukon its course of migration is up the river from its mouth.

[2] List of Birds of Alaska, by W. H. Dall and H. M. Bannister < Trans. Chicago Academy of Sciences, I, pt. II, 267–310, 1869; also Alaska and its Resources, by W. H. Dall, Boston, Lee & Shepard, 1870.

[3] Sketch of the Flora of Alaska, by J. T. Rothrock < Annual Report Smithsonian Institution, 1867, 433–463.

In 1874, with the establishment of a meteorological station at St. Michael, work was begun by Lucien M. Turner. He collected about St. Michael and secured specimens from the fur traders and natives on the Yukon as far up as Fort Yukon. The results of his work were published in the Arctic Series of the Signal Service.[1]

Turner was relieved in 1877 by E. W. Nelson, who continued to collect specimens until 1881. His work was more extensive than that of Turner, but was carried out along the same lines. He made several trips up and down the coast from St. Michael, and also worked about the Yukon delta and up the river as far as Anvik. L. N. McQuesten, who conducted a trading post at Fort Reliance, furnished him with numerous specimens and much valuable information. The results of Nelson's work were also published in the Arctic Series of the Signal Service[2] and form by far the most valuable contribution to the natural history of Alaska yet made. In 1889 an important report[3] was published by Dr. George M. Dawson, covering the region of the sources of the Yukon and down as far as Fort Selkirk. This report contains detailed descriptions of the physical features of the upper river, notes on natural history, particularly on the distribution of trees, and a list of plants by John Macoun.

NEW SPECIES.

Nine new species and subspecies of mammals are described in the present report. They are as follows:

Sciuropterus yukonensis.
Sciurus hudsonicus petulans.
Eutamias caniceps.
Spermophilus empetra plesius.
Neotoma saxamans.
Fiber spatulatus.
Lepus saliens.
Lutreola vison ingens.
Mustela americana actuosa.

In the collection of birds, three new forms were found. These have been described by Dr. Bishop[4] as follows:

Canachites canadensis osgoodi.
Sayornis saya yukonensis.
Contopus richardsoni saturatus.

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[1] Contributions to the Natural History of Alaska, by L. M. Turner, Arctic Series, Signal Service, No. II, Washington, 1886.

[2] Report upon Natural History Collections made in Alaska, by E. W. Nelson, Arctic Series, Signal Service, No. III, Washington, 1887.

[3] Geological and Natural History Survey of Canada, Annual Report, III (1887–88), Pt. I, 6 B–277 B, 1889.

[4] Auk, XVII, 113–120, April, 1900.

Besides the above, several new mammals which come within the scope of the present report have been recently described by Dr. Merriam.[1] These are as follows:

Spermophilus osgoodi.
Lemmus yukonensis.
Lemmus alascensis.
Dicrostonyx nelsoni.
Erethizon epixanthus myops.
Lepus americanus dalli.
Lepus othus.
Vulpes hallensis.
Sorex personatus arcticus.
Sorex tundrensis.

In addition to these, three new forms recently described by Witmer Stone[2] should be mentioned:

Dicrostonyx hudsonius alascensis (equals *D. nelsoni* Merriam).
Putorius rixosus eskimo.
Lynx canadensis mollipilosus.

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[1] Proc. Wash. Acad. Sci., II, 13–30, March 14, 1900.

[2] Proc. Acad. Nat. Sci. Phila., March 24, 1900, 33–49.

MAMMALS OF THE YUKON REGION.

By Wilfred H. Osgood.

INTRODUCTION.

The following list, primarily based on collections made during the past year, includes all the known mammals of the Yukon region. Besides the species which belong strictly to the Yukon, are included those found in the Lynn Canal and White Pass districts and those known to occur at St. Michael. This makes a list containing the majority of the mammals known from Alaska, which is not, however, intended to be comprehensive, but should be considered as supplementary to the list published by Nelson in 1887. As may be seen from the itinerary, our collections were made during a hasty trip from the coast of southeastern Alaska to the head waters of the Yukon and thence down the river to St. Michael. Good series of all the common small mammals were secured, but the larger and rarer species were not often obtained. It was not only difficult to secure specimens of the larger mammals, but it was hard to gain much accurate information in regard to them. Most of the miners we met had been in the country but a short time and their knowledge of animals was limited; natives were seldom met on the upper river and the few that were interviewed seemed disinclined to talk. The fur trade on the Yukon has dwindled to comparatively meager proportions. The Indians still bring a few furs to the traders every year and receive pittances of flour and tea in return; but the trade is apparently very small and were it not for the transportation business which has recently become so important, the large companies would doubtless find it difficult to maintain themselves.

In identifying the recently collected specimens and studying their geographical distribution, it has been necessary to refer constantly to the specimens collected by Kennicott, Dall, Nelson, and Turner. Many of these, which are in the National Museum, were found to be in poor condition and required considerable renovating to make them comparable with modern specimens. For the free use of these specimens I am indebted to Gerrit S. Miller, jr., assistant curator of mammals in the National Museum. I am also indebted to Outram Bangs for the use of specimens, and E. W. Nelson for much valuable information. The identifications of some of the mammals have been verified by specialists as follows: The species of *Sorex* by Dr. C. Hart Merriam; of *Microtus* by Vernon Bailey, and of *Zapus* by Edward A. Preble. All measurements are in millimeters.

LIST OF SPECIES AND SUBSPECIES.

1. *Rangifer montanus* Seton-Thompson.
2. *Rangifer arcticus* (Richardson).
3. *Rangifer tarandus* (Linnæus).
4. *Alces gigas* Miller.
5. *Ovis dalli* Nelson.
6. *Oreamnos montanus* (Ord).
7. *Sciuropterus yukonensis* sp. nov.
8. *Sciurus hudsonicus* Erxleben.
9. *Sciurus hudsonicus petulans* subsp. nov.
10. *Eutamias caniceps* sp. nov.
11. *Spermophilus empetra plesius* subsp. nov.
12. *Spermophilus osgoodi* Merriam.
13. *Arctomys caligatus* Eschscholtz.
14. *Castor canadensis* Kuhl.
15. *Mus decumanus* Pallas.
16. *Peromyscus oreas* Bangs.
17. *Peromyscus maniculatus arcticus* (Mearns).
18. *Neotoma saxamans* sp. nov.
19. *Evotomys dawsoni* Merriam.
20. *Evotomys dawsoni alascensis* (Miller).
21. *Microtus mordax* (Merriam).
22. *Microtus drummondi* (Aud. and Bach.).
23. *Microtus xanthognathus* (Leach).
24. *Microtus operarius* (Nelson).
25. *Fiber spatulatus* sp. nov.
26. *Synaptomys dalli* Merriam.
27. *Lemmus yukonensis* Merriam.
28. *Lemmus alascensis* Merriam.
29. *Dicrostonyx nelsoni* Merriam.
30. *Zapus hudsonius alascensis* Merriam.
31. *Erethizon epixanthus myops* Merriam.
32. *Ochotona collaris* (Nelson)
33. *Lepus saliens* sp. nov:
34. *Lepus americanus dalli* Merriam.
35. *Lepus othus* Merriam.
36. *Lynx canadensis mollipilosus* Stone.
37. *Canis occidentalis* Richardson.
38. *? Vulpes fulvus* (Desmarest).
39. *Vulpes hallensis* Merriam.
40. *Ursus americanus* Pallas.
41. *Ursus horribilis alascensis* Merriam.
42. *Lutra canadensis* (Schreber).
43. *Lutreola vison ingens* subsp. nov.
44. *Putorius arcticus* Merriam.
45. *Putorius cicognani alascensis* (Merriam.)
46. *Putorius rixosus eskimo* Stone.
47. *Mustela americana actuosa* subsp. nov.
48. *Mustela pennanti* Erxleben.
49. *Gulo luscus* (Linnæus).
50. *Sorex personatus streatori* Merriam.
51. *Sorex personatus arcticus* Merriam.
52. *Sorex obscurus* Merriam.
53. *Sorex tundrensis* Merriam.
54. *Myotis lucifugus* (Le Conte).

ANNOTATED LIST OF SPECIES.

Rangifer montanus Seton-Thompson. Mountain Caribou.

Rangifer montanus Seton-Thompson, Ottawa Naturalist, XIII, No. 5, 6, Aug. 11, 1899; Allen, Bull. Am. Mus. Nat. Hist., N. Y., XIII, 1-18, April 3, 1900.

This large woodland caribou is reported as quite common in northern British Columbia about the head waters of the Yukon and for an indefinite distance northward. It does not occur on the coast south of Cook Inlet, but is reported from many points immediately beyond the summit of the coast mountains. It prefers the higher ground in summer and is not found along river bottoms like the moose, for which reason few are killed by parties descending the river. Its flesh is smoked and dried by the Indians for winter food, and when so cured is preferred to all other meat of the country. The hides, like those of the moose, serve the natives for various articles of clothing and are utilized especially for sleeping robes.

Rangifer arcticus (Richardson). Barren Ground Caribou.

The barren ground caribou ranges over nearly all of extreme northern North America from northwestern Labrador to the Aleutian Islands. It was formerly abundant over this great territory, but is now quite rare. Even at the time of Nelson's work in 1877 it had become comparatively uncommon, though it was once common all about Norton Sound and for some distance up the river. The southern and interior limits of its range are uncertain. During our stay in St. Michael, I saw half a dozen skins which had been secured near Andraefski, 90 miles above the mouth of the Yukon. There are specimens in the National Museum from Nushagak and Unalakleet, Alaska; and from Rampart House and La Pierre House, Northwest Territory.

Rangifer tarandus (Linnæus). Domesticated Reindeer.

During the past few years, as is well known, an effort has been made to introduce domesticated reindeer from Siberia into Alaska. The animals as a rule have been carefully herded, but in a few cases they have had opportunities to stray away and run wild. The herd that had perhaps the best chance to stray was one which was brought from Lapland to Haines in 1898, and driven inland over the Dalton trail. A short time after it started several of the animals were seen in the forest near Haines, and one of them was killed. This was the only instance of the kind brought to my attention, but I have no doubt that reindeer have occasionally wandered from the care of the herders at other times and in other places.

Alces gigas Miller. Alaska Moose.

Alces gigas Miller, Proc. Biol. Soc. Wash., XIII, 57–59, May 29, 1899.

The Alaska moose, as has frequently been stated, is the largest of the deer family in North America. Its distribution along the Yukon extends from Lakes Atlin and Tagish at least to the mouth of the Tanana and probably somewhat farther. Whymper[1] says that it was 'never known as low as Nulato,' even in the time of its greatest abundance. It is evident, however, from the record of Nelson[2] at the Yukon delta, and that of Richardson[3] at the mouth of the Mackenzie, that it does occasionally leave its favorite woodlands of the interior and wander as far as the Arctic coast. At present it is still quite numerous, but is chiefly confined to the small streams tributary to the Yukon. According to reports which came to me it is abundant in the region about the upper waters of the Stewart, Pelly, and MacMillan rivers. Along the great river itself numbers have been killed during the recent influx of prospectors. At the beginning of the Klondike rush, it was not uncommon for a party to secure one or two moose while descending the river, but such is rarely the case at present. Our party failed to see any, though we spent nearly three months in the region; during this time we heard of but two animals being killed, one near the foot of Lake Lebarge and another on upper Charlie Creek, a short distance above Circle; both were secured by Indians. We saw comparatively few fresh tracks.

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[1] Travels in Alaska and on the Yukon, 245, 1869.

[2] Report upon Natural History Collections in Alaska, 287, 1887.

[3] Fauna Boreali-Americana, 233, 1829.

In winter, moose meat is the staple diet of both Indians and whites and has readily sold in the mining camps at $1 to $2 per pound. Such a price, even in this country of high wages, has been a great incentive to hunting, and many a miner has left his claim to pursue the moose. The hides also are a source of profit, particularly to the Indians, who tan them and make them into mittens and moccasins. What the Indians do not need they sell readily to miners and prospectors. It is difficult to estimate the number of animals that have been killed, but it must be very large, for the demand has been steady and a comparatively large population has been supplied with meat. On one hunt, an account of which has been given by Tappan Adney,[1] 44 moose were killed in about one month, and a single party of Indians was credited with a total of 80 moose and 65 caribou in one winter.

Ovis dalli (Nelson). Dall Mountain Sheep.

Most of the specimens of the Dall sheep which have reached our museums were secured in the vicinity of Cook Inlet, but the animal occurs in nearly all the high mountains of Alaska, and in the north ranges to the Arctic coast. Since we were at a distance from the mountains during the greater part of our trip, I was unable to secure much information in regard to the distribution of the species. Sheep are said to occur about the West Arm of Lake Bennett, and Windy Arm of Lake Tagish. A prospector with whom I talked at Lake Tagish said he had seen and killed them at both of these places. Lake Bennett is not far from the type locality of *O. stonei*, and it is possible that this species occurs there with *O. dalli*. Both white and gray sheep are reported, though all are said to be white in winter. I was told that white sheep were killed some years ago on the cliffs about Lake Lebarge, but I failed to find signs of them there. Prospectors at Fort Selkirk say that sheep are always to be found in the mountains along Pelly River, particularly in the MacMillan Mountains[2] near the mouth of MacMillan River, and they were also reported from the head waters of the Stewart and from the Tanana Hills.

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[1] Harper's Magazine, C, 495–507, March, 1900.

[2] The sheep from the MacMillan Mountains are said to be the 'black sheep,' which name could hardly apply to *O. dalli*, but is the name commonly given to *O. stonei*. If *stonei* really does occur in these mountains the record is a very interesting one, and the locality much farther north than any from which the species has been previously recorded.

Oreamnos montanus (Ord). Mountain Goat.

Goats occur on the high granite cliffs which inclose the upper part of Lynn Canal; they are also common on the mountains near White Pass and about the rocky walls of Lake Bennett. I was told that they had been killed recently at the upper end of Little Windy Arm on Lake Tagish, but I could obtain no reliable report of their occurrence in the interior beyond this point. At Lake Lebarge they were very doubtfully reported. Their range is known to extend north to White Pass in the coast mountains at least to Copper River,[1] but does not reach far into the interior. Hunters from the mountains about the upper waters of the Pelly and Stewart rivers asserted positively that none had been heard of in that region.

The station agent at Glacier, near White Pass summit, told me that goats frequently appear on the cliffs within easy view of his house. He also showed me the hide of one that had been killed near there a short time before our arrival. I made one short trip into these mountains, but failed to see any goats. The character of the cliffs is ideal for them, but they had evidently gone farther back to their summer feeding grounds, as the abundant tracks and dung were a few weeks old.

Sciuropterus yukonensis sp. nov. Yukon Flying Squirrel.

Type from Camp Davidson, Yukon River, near Alaska-Canada boundary. No. $\frac{10008}{35326}$, U. S. Nat. Mus. Collected December 8, 1890, by R. E. Carson.

Characters.—Size largest of North American flying squirrels; tail exceedingly long; color rather dark, underparts suffused with fulvous; skull slightly characterized.

Color.—Top of head, neck, and upperparts to base of tail pale cinnamon or between the wood brown and cinnamon of Ridgway; underfur bluish black, partially exposed on legs and membranes; underparts dull whitish, irregularly suffused with cinnamon fawn; feet dusky above, lightly edged with creamy white, buffy white below; cheeks and sides of head ashy, lightly mixed with cinnamon; end of nose slightly paler than top of head, not light ashy as in *S. sabrinus;* black eye-ring prominent; tail light fawn below, with a light edging of dusky, becoming broader toward tip; tail above fawn heavily mixed with black, which predominates for terminal fifth.

Skull.—Size large, slightly larger than in *S. alpinus;* audital bullæ larger; width at postorbital constriction greater; molars heavier, particularly the mandibular series.

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[1] H. T. Allen, Science, VII, 57, 1886.

Measurements.—Total length 365; tail 180; hind foot (measured dry) 41. Skull: Occipitonasal length 40; zygomatic breadth 25; postorbital constriction 10.

Remarks.—This species is distinguished from both *S. sabrinus* and *S. alpinus* by its large size and very long tail, but it is also very different from either in color. It is evidently a very rare squirrel, as the type and one topotype are the only specimens known. A specimen from Chilkoot Inlet which may possibly be this species has been recorded by Dr. George M. Dawson.[1] Camp Davidson is the northernmost point at which the genus *Sciuropterus* is known to occur. The type and one other specimen were secured by R. E. Carson, who was a member of the boundary survey party of the U. S. Coast and Geodetic Survey under J. E. McGrath, in 1890. Dr. W. W. Kingsbury, also a member of the party, writes me as follows in regard to these specimens:

> I send you the following notes taken from my journal regarding two Flying Squirrels which were captured by a member of our party while in Alaska, in 1890; their skins were sent to the National Museum at Washington.
>
> The female was caught Dec. 8th, 1890, and the male Dec. 9th, 1890. Both squirrels were caught in a trap known as the 'dead fall,' which was set by R. E. Carson for marten. The traps were set in the bed of a frozen stream, where it ran through a clump of spruce trees about one-fourth of a mile back from the Yukon river. This clump of trees is about 2½ miles east of the International boundary line, and on the east bank of the Yukon river.
>
> We showed these skins to both McQuesten and Mayo, two traders who had been in that country over twenty years, and who said that they had seen Flying Squirrels along the Yukon river quite a number of times before, and had also seen them at Ft. Reliance and Ft. Yukon; but had not seen any of them for a number of years before this date. We also showed the skins to an Indian, who said these squirrels would attack a man by flying in his face, and the Indians would not eat them because the squirrels ate dirt.
>
> During the winter and spring of that year, I hunted very carefully in the vicinity where these squirrels were captured, but failed to find further trace of them. The stomachs of both of these squirrels were empty. The traps in which they were caught were set for martens, and two or three had been caught, but none were caught in these traps after the squirrels were captured.

Sciurus hudsonicus Erxleben. Hudson Bay Red Squirrel.

All the red squirrels from the Yukon basin and northern Alaska, as far as can be determined at present, are referable to *Sciurus hudsonicus* 'proper,' although those from the Upper Yukon show considerable tendency toward *S. h. streatori.* Most of the Yukon specimens are in summer pelage, while the few available specimens from eastern Canada and the vicinity of Hudson Bay are in winter pelage, so that close comparison is not possible. Specimens from various points along the Yukon from Bennett to Nulato have been examined. The

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[1] Geol. and Nat. Hist. Survey of Canada, Annual Report, III (1887-88), pt. I, 50 A, 1889.

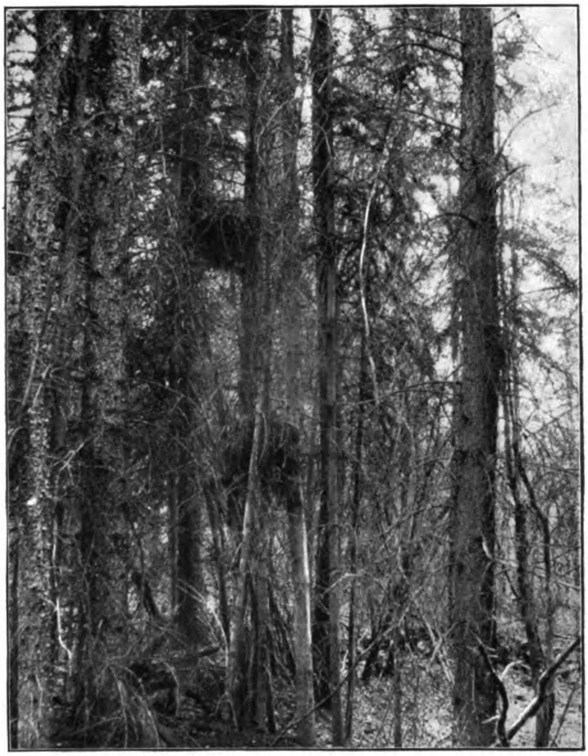

FIG. 1.—NESTS OF RED SQUIRRELS IN SPRUCE THICKET.

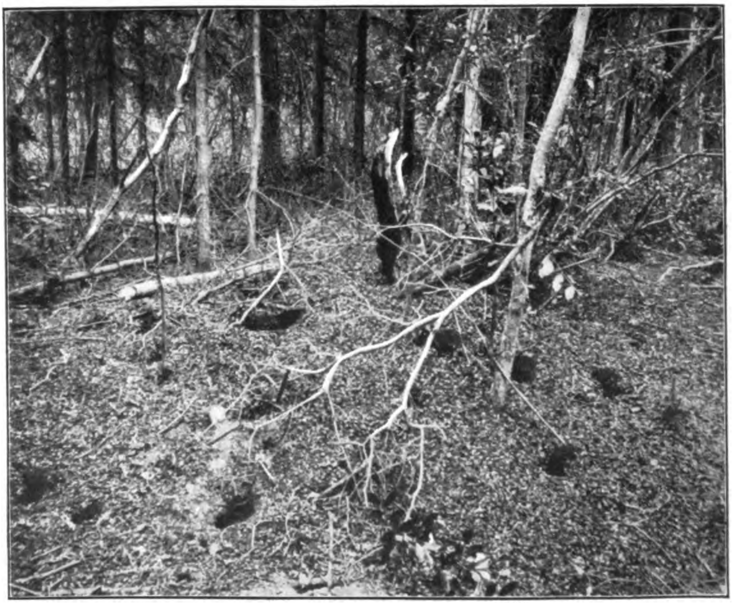

FIG. 2.—BURROWS MADE BY RED SQUIRRELS IN LOOSE SCALES STRIPPED FROM SPRUCE CONES.

animal is exceedingly abundant in all the spruce forest, and doubtless ranges northward to the limit of trees.

Evidences of its activity are to be found all through the spruce forest. Its globular nests of grass, moss, bark, and refuse are common (Plate IV, fig. 1), and are usually situated near the trunk of some slender spruce, 10 or 20 feet from the ground. Sometimes several will be found in the same tree, and a half dozen or more are very often to be seen at the same time. Little excavations in the moss show where the chickarees have been digging for roots; and spruce cones tucked away in these and other out-of-the-way places are further evidence of their sagacity. The ground is often strewn for some distance with the scales of spruce cones which they have stripped (Plate IV, fig. 2). Near Lake Marsh I found one such place 20 feet square which was covered 6 inches deep with scales.

Sciurus hudsonicus petulans subsp. nov.

Type from Glacier, White Pass, Alaska (altitude 1,870 feet). No. 97457, U. S. Nat. Mus., Biological Survey Collection, ♀ ad. Collected June 4, 1899, by W. H. Osgood. Original No., 370.

Characters.—Similar to *S. hudsonicus*, but larger and darker; central portion of tail darker and with slight mixture of black; submarginal black in tail wider; edging of tail much darker; underparts not pure white in summer. Similar to *Sciurus h. streatori*, but more reddish; central portion of tail with much less admixture of black; subterminal black in tail much narrower. Somewhat similar to *S. vancouverensis*, but paler and cranially different; lateral stripe much more prominent; submarginal and subterminal black in tail narrower; median dorsal stripe less suffused; median dorsal hairs of tail with much less black.

Color.—Summer pelage: Upperparts between the raw umber and Prout's brown of Ridgway; top of head slightly darker than back; lateral line prominent, intense black; forelegs and feet russet; underparts lightly washed with fulvous; median dorsal portion of tail hazel, slightly mixed with black-tipped hairs; submarginal and subterminal black in tail rather limited; edging of tail ochraceous; under surface of tail paler than upper, the grayish roots of the hairs showing through. *Winter pelage:* Similar to the corresponding pelage of *S. hudsonicus*, but considerably darker; median dorsal line more diffuse; tail darker and with greater admixture of black in central portion.

Skull.—Similar to that of *hudsonicus* and its other subspecies; nasals longer and posteriorly more compressed than in *S. vancouverensis;* orbital arch with a sharp indentation between lachrymal and postorbital process. (See Plate V, fig. 2.[1])

Measurements.—Average of two specimens from type locality: Total length 303; tail 120; hind foot 50.

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[1] Topotype No. 97460, U. S. Nat. Mus. Compare with fig. 1, *S. vancouverensis*, No. 71889, U. S. Nat. Mus., from Goldstream, Vancouver Island.

Remarks.—The closest relationship of this red squirrel is evidently with *hudsonicus* of northern Alaska.[1] A single specimen from Yakutat Bay shows a decided tendency toward the northern form, and those from Cook Inlet are clearly referable to it. A more or less imperfect specimen from Inverness, British Columbia, indicates a possible intergradation with *Sciurus h. streatori.* There is ample material demonstrating by skulls as well as by color that it has no very close relationship to *S. vancouverensis.* My specimens of *petulans* taken early in June are in new summer pelage or in old winter pelage just previous to or in process of change. The latter doubtless does not fairly represent the winter pelage; but in making comparison with eastern specimens, I have chosen those in a similar condition.

About Lynn Canal and on the southwest side of White Pass I found these red squirrels abundant. Several at Glacier had become quite tame, and came every day to the cabin of one of the railroad hands to be fed. They have all the vivacious energy, curiosity, and vocal accomplishments of their Eastern cousins, and fully maintain their reputation for rollicking good nature and fearlessness.

Eutamias caniceps sp. nov. Gray-headed Chipmunk.

Type from Lake Lebarge, Northwest Territory, Canada. No. 99200, U. S. Nat. Mus., Biological Survey Collection, ♀ ad. Collected July 13, 1899, by W. H. Osgood. Original No., 603.

Characters.—Similar to *E. borealis*, but grayer, particularly the head, tail, and feet; postauricular spots more prominent; underparts pure white.

Color.—*Summer or postbreeding pelage:* Sides bright ochraceous, extending from flanks forward and stopping immediately below ears, but interrupted at shoulders by the extension of gray from arm; five black stripes on back very distinct and, except outer ones, entirely unmixed with ochraceous; outer pair of light stripes pure white, prominent, not continuous with postauricular spots; inner light stripes bluish white mixed with ochraceous; top of head brownish gray; postauricular spots bluish white, connected with throat by a continuous light stripe running below ear; light stripes on sides of head prominent, almost pure white; dark stripes rufous mixed with blackish, narrower and darker than in *E. borealis;* underparts pure white; feet yellowish white. *Worn pelage:* General effect of upperparts olive gray relieved by the black and white stripes of the back and faint traces of the fulvous, which has been worn away; feet grayish white; tail above black, grizzled and overlaid with white, below clay color submargined by black and margined by white.

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[1] The *hudsonicus* of northern Alaska is here considered the same as that from eastern Canada, but will doubtless prove separable when an abundance of material in all pelages is available.

Skull.—Similar to that of *E. borealis*, but with a slightly fuller braincase and larger audital bullæ.

Measurements.—Type (from dry skin): Total length 223; tail vertebræ 103; hind foot 32.

Remarks.—The type[1] of *E. borealis* from Fort Liard, British Columbia, is missing, but specimens from Fort Simpson, which is not far from Fort Liard, and other points east of the Rocky Mountains, are available for comparison. These are all much suffused with fulvous, and are very easily distinguished from those of the Upper Yukon. *E. caniceps* is characterized not only by gray head and cheeks, but by gray feet, gray edging to tail, and pure white underparts.

This species is found from the headwaters of the Yukon about Lake Lindeman to the vicinity of Fort Selkirk, where it was last seen by our party. I found it most common in the dry and open rocky country about Lake Bennett and Lake Lebarge, and a few were taken in the thickets of *Lepargyræa* about Lake Marsh and Fifty-Mile River. It is not abundant anywhere in the region, but is remarkably tame and unsuspicious. I seldom saw more than two or three in a half day's tramp, but these would often frisk about within a few feet of me as if entirely oblivious of my presence.

Spermophilus empetra plesius subsp. nov. Bennett Ground Squirrel.

Type from Bennett City, head of Lake Bennett, British Columbia. No. 98931, U. S. Nat. Mus., Biological Survey Collection, ♀ ad. Collected June 19, 1899, by W. H. Osgood. Original No., 465.

Characters.—Similar to *S. empetra* and *S. kadiacensis*, but smaller; general color less fulvous; under side of tail always clear bright cinnamon rufous; molar teeth relatively much larger than in *kadiacensis;* skull small and light and otherwise slightly peculiar.

Color.—*Postbreeding pelage:* Above, mottled as in *S. empetra*, but general color less fulvous; upperparts, mixed black, white and yellowish gray extending forward to top of head, becoming narrower and slightly grayer between shoulders; top of head chestnut mixed with black; nose and forehead clear hazel; under side of body cinnamon rufous paling to nearly white around chin and extending to sides of body, neck and cheeks, and both sides of legs; under side of tail somewhat deeper cinnamon rufous margined by yellowish white; subterminal black in tail less extensive than in *empetra* and *kadiacensis;* median part of upper side of tail grizzled black and yellowish, narrow submargin and subterminal zone black, the whole edged and overlaid with yellowish white. The hairs of the back in *S. plesius* are of two kinds, some being of several colors arranged in zones and some pure black for their entire length. The former, which are most abundant, are dark sooty plumbeous at the base followed by a zone of light gray, then one of black, then yellowish white, and finally a black tip. In *S. empetra*, the arrangement is practically the same, but the upper part of the light gray zone blends into fulvous. As this is the widest zone, it gives a fulvous suffusion to the entire upperparts of the animal. In *plesius* the black submargin of the tail never shows through on the under side. *Worn spring pelage:* Upperparts yellowish gray; top of head, forehead, and nose cinnamon rufous; thighs with faint suggestions of rufous; shoulders and neck hoary; sides and underparts grayish white washed with yellowish and flecked with ochraceous; feet pale buffy ochraceous; tail paler than in postbreeding pelage.

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[1] See Allen, Bull. Am. Mus. Nat. Hist., N. Y., III, 109, 1890.

Skull.—Similar to that of *S. empetra* from Unalaska, but smaller and lighter; nasals shorter and wider in proportion to their length; postpalatal notch extending farther forward, being almost on a plane with the last molar; molar teeth decidedly larger than those of *kadiacensis.*

Measurements.—Type (from dry skin): Total length 345; tail vertebræ 93; hind foot 50. Skull of type: Basal length 45; zygomatic breadth 35; postorbital constriction 13; length of nasals 18; least width of nasals 6; alveolar length of molar series 13.

Remarks.—The material representing *Spermophilus empetra* is still very scanty and imperfect. Specimens from the Arctic coast are few in number and poor in quality, while from Hudson Bay one flat skin, unaccompanied by a skull, is all I am able to find. I have considered this (No. 13932, U.S.N.M.) to be typical of *empetra* and have used it in making skin comparisons. Since it agrees fairly well with specimens of the ground squirrel which has been introduced on Unalaska, I have used the skulls of these for skull comparisons. Specimens from Bristol Bay and the Alaska peninsula are apparently intermediate between *empetra* and *plesius.* *S. kadiacensis* is apparently confined to Kadiak Island, as specimens from the mainland immediately opposite the island are cranially and dentally distinct. The southern members of the group, *columbianus* and *erythroglutæus*, also need not be considered, as they are very different from *empetra* and *plesius.*

S. plesius was first met with on the south side of White Pass near Glacier, where a small colony was found on a steep rocky slope above the canyon. They were active here in early June while patches of snow still lay on the ground. On the summit of White Pass another small colony was found, and at Lake Bennett they were very abundant. Here their burrows are to be found wherever the conformation of the rocks affords lodgment of sufficient soil. From Bennett on to Fort Selkirk they are exceedingly abundant. We saw them daily about all the lakes, and as we floated down Fifty-Mile and Thirty-Mile rivers, we often saw them bobbing in and out of their burrows or scurrying along their little trails which score the banks.

From sunrise till late in the afternoon, their sharp clicking cries rang out across the water, so that, if not to be seen, they at least reminded us of their presence nearly all the time. When alarmed, they stand erect on their haunches near their burrows and violently utter their sharp, high-pitched *clickety click* as long as the exciting cause is in sight, always emphasizing each cry by vigorously slapping their short tails against the ground behind them. As a rule they were quite wary, and it was not possible to get within gunshot without some concealment and careful stalking. The limit of the range of the species along the river is near Fort Selkirk. The last specimen secured was caught near Rink Rapids, but I learned that quite a colony of ground squirrels exists on the west bank of the river just below Fort Selkirk.

Spermophilus osgoodi Merriam. Fort Yukon Ground Squirrel.

Spermophilus osgoodi Merriam, Proc. Wash. Acad. Sci., II, 18, March 14, 1900.

From Fort Selkirk, near the limit of *Spermophilus plesius* in the interior, nearly to Circle, we saw no signs of ground squirrels of any kind. Just before reaching Circle, however, we began to see unmistakable signs of them and were soon attracted to a small colony by their clicking calls which reached our ears as we floated down in midstream. The call is executed in about the same time as that of *S. plesius*, but its pitch is much lower and its effect on the ear is utterly different. It suggests the click of castanets. On going ashore we found their burrows and connecting paths scattered over quite an area on the hillside. The colony occupied the open hillside and a few ledges of loose rock, and even extended down into a thicket of alder and willow at the foot of the hill. The animals were very shy and became much excited at our approach. Their long tails were very noticeable in marked contrast to the short ones of *S. plesius*, which we had been accustomed to seeing. Fifteen specimens were secured.[1] At this time (Aug. 14) they were all very fat and in splendid postbreeding pelage; the entire underparts were rich ferruginous without a trace of any other color; the back was very dark, and the long tail was full and bushy. One specimen was pure glossy black with faint shadowy indications of vermiculation on the back. Among the specimens in the National Museum from Fort Yukon are several in this melanistic condition, showing that it is not uncommon. The range of this species on the Yukon begins about 20 miles above Circle and extends at least to Fort Yukon and probably to the mouth of the Tanana.

Arctomys caligatus Eschscholtz. Hoary Marmot.

Six specimens of the hoary marmot were secured in the White Pass region and about Lake Bennett, where it was common. It is confined to rocky, mountainous parts of the Hudsonian zone, and consequently we did not meet with it during the latter part of our trip, and only heard of it through reports from the mountains at the headwaters of the White and Tanana rivers. As elsewhere, it is familiarly known as the 'whistler,' although occasionally rather inappropriately called 'ground hog.' Its long drawn whistle is peculiarly mournful, particularly when it breaks the deathly silence of some rocky canyon. It loves to stretch at full length on top of a large rock and bask in the sun. I frequently found it quietly enjoying itself in this manner.

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[1] This valuable series was unfortunately destroyed.

Castor canadensis Kuhl. American Beaver.

It hardly seems possible that half a million or more beaver skins have been secured in the Territory of Alaska. The animal is now almost as rare there as it is in the United States, the inevitable result of continued pursuit by both whites and natives, which has so many parallels that it is useless to emphasize it here. At Fort Selkirk I saw several beaver skins taken on a small tributary of Stewart River, and at St. Michael I found a very few in the warehouses of the trading companies. Beyond this I saw or heard nothing of them.

Mus decumanus Pallas. Norway Rat.

Large rats are exceedingly abundant at St. Michael. Their introduction must have been effected very recently, as they were unknown there at the time of Nelson's work. Unalaska has long been their northern limit on the Pacific coast. They find shelter about the wharves and lumber piles at St. Michael and also infest the buildings, particularly food warehouses. Their distribution will undoubtedly soon be extended all along the Yukon by means of the many steamers now plying between St. Michael and Dawson.

Peromyscus oreas Bangs. Bangs White-footed Mouse.

Peromyscus oreas Bangs, Proc. Biol. Soc. Wash., XII, 84, March 24, 1898.

Long-tailed mice were taken at Skagway, Glacier, Summit, Bennett, Caribou Crossing, Fifty-Mile River, and Rink Rapids. In general they seemed to be more woodland loving than the short-tailed species, though at Bennett a number were taken among bare rocks at the very water's edge. I first noticed them here while walking along the shore at night. They were darting in and out among the rocks, chasing each other as if playing a game of tag, and often four or five were in sight at once. *P. oreas* from the type locality is somewhat intermediate between my specimens and those which come from the coast of Puget Sound and southern British Columbia. Northern specimens are slightly larger, paler, and less ruddy brown than typical *oreas*. They are very similar in color to *canadensis* and increase the probability that the latter has a transcontinental range. Their skulls are larger and have fuller braincases than those of either *oreas* or *canadensis.*

Peromyscus maniculatus arcticus (Mearns). Arctic White-footed Mouse.

Hesperomys leucopus arcticus Mearns, Bull. Am. Mus. Nat. Hist., N. Y., II, 285, Feb., 1890.

A short-tailed white-footed mouse was found to be very common from Lake Marsh to Lake Lebarge. Thirty specimens were secured, most of them about the crevices of low ledges of rock along the lake shores. The name *arcticus* is only tentatively used for these specimens, as its applicability can not be positively known until a series of Labrador specimens is obtained. My specimens do not differ from topotypes of *arcticus*, and these in turn, as stated by Bangs,[1] do not differ in color and size from typical *maniculatus.* The description of the skull of the Great Whale River specimen examined by Bangs, however, does not agree well with the characters of the skulls of *arcticus*, so it seems advisable to recognize *arcticus* as a subspecies of *maniculatus.* It is probable that more material will amply justify this treatment of the western form.

Neotoma saxamans sp. nov. Northern Bushy-tailed Rat.

Type from Bennett City, head of Lake Bennett, British Columbia. No. 98923, U. S. Nat. Mus., Biological Survey Collection, ♂ ad. Collected June 19, 1899, by W. H. Osgood. Original No., 462. (See Plate V, fig. 4.)

Characters.—Similar to *Neotoma cinerea drummondi*, but somewhat darker; underparts pure white; skull strongly characterized.

Color.—(Type:) Above, grayish fawn mixed with black, becoming brighter on sides, where the quantity of black is much diminished; underparts and feet pure white; eyelids intense black with a limited sooty area about them; nose and anterior cheeks ashy; tail slaty above, white below.

Skull.—Similar to that of *N. drummondi* (Plate V, fig. 3[3]) but with interorbital space narrower; nasals narrower and more attenuate posteriorly; maxillary arm of zygoma lighter; sphenopalatine vacuities open; ventral surface of occipital with a high trenchant median ridge; front of incisors very pale.

Measurements.—Type (from dry skin): Total length 452; tail vertebræ 192; hind foot 46. Skull of type: Basal length 52; zygomatic breadth 29; interorbital width 5; length of nasals 23.

Remarks.—*Neotoma saxamans* differs from *N. cinerea*,[2] *N. occiden-*

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[1] Am. Naturalist, XXXII, 496, July, 1898.

[2] *Neotoma c. columbiana* Elliot does not differ cranially from *N. cinerea*, and therefore need not be considered in this connection.

[3] No. 75907, U. S. Nat. Mus., from Jasper House, Alberta.

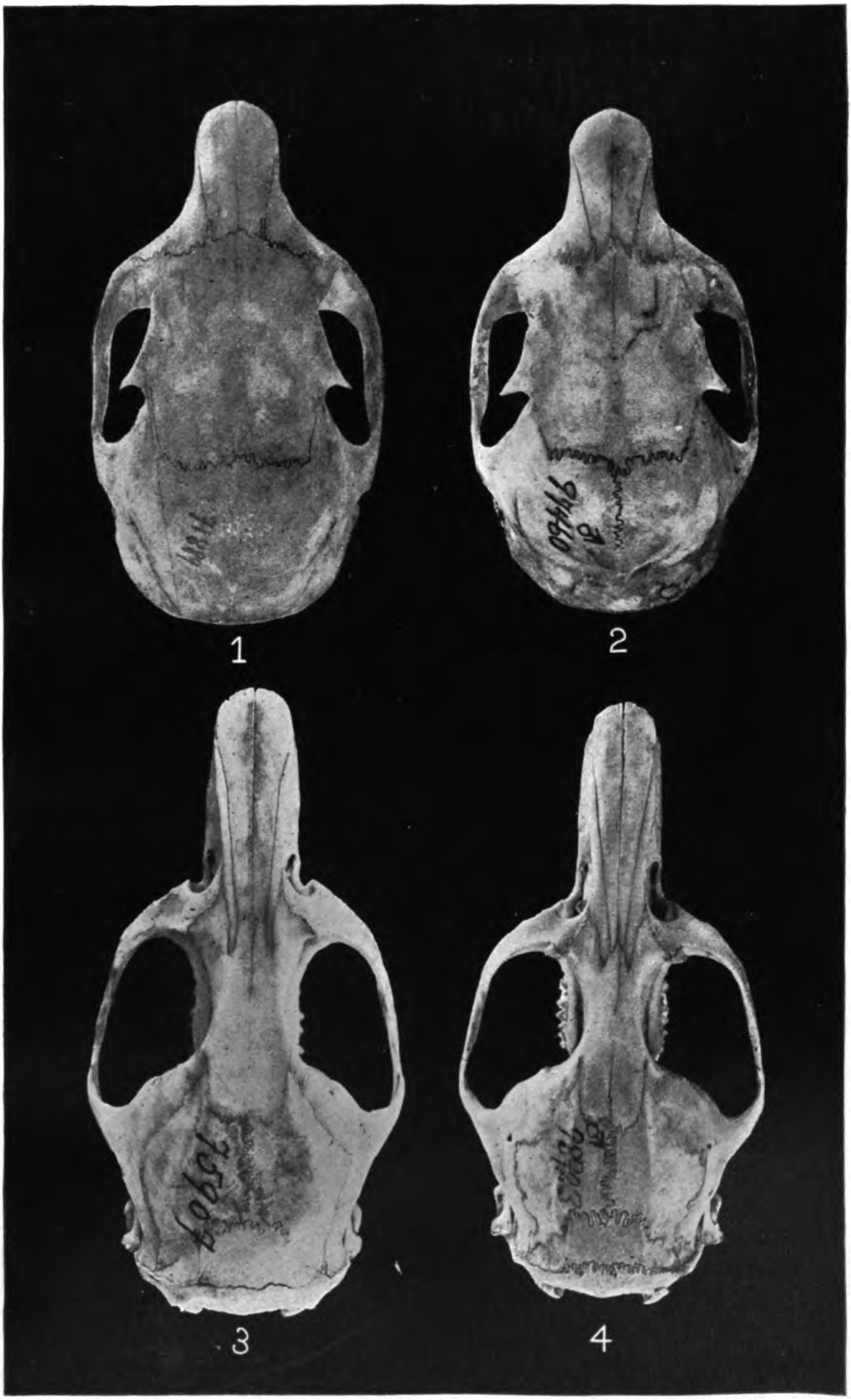
talis, and *N. drummondi* chiefly in its long attenuate nasals, open sphenopalatine vacuities, and pale incisors. The only specimens secured were caught in a slide of large granite bowlders at the head of Lake Bennett. It was ascertained to occur, however, from White Pass to the Semenow Hills. In the cliffs above Glacier on the coast side of White Pass I found signs of *Neotoma*, and once one peeped out of a crevice at me while I was busily engaged stalking a hoary marmot. It also occurs sparingly in the cliffs about Lake Lebarge and in the Semenow Hills, where the last evidences of its presence were seen. This distribution makes it the northernmost species of the genus.

One night about 10.30, as I was returning to camp at Bennett, I saw one of these rats frisking about in the rocks. It was still quite light, and I immediately stopped and stood motionless while he darted in and out of the rocks. His movements were utterly noiseless and so quick that my eye could scarcely follow them. For some time his little whiskered nose appeared and disappeared at various openings in the rocks about ten feet away. Each time he would look steadily at me for a moment or two and then silently vanish. Gradually his curiosity overcame his caution, and in decreasing circles he came nearer and nearer until he bobbed out right before me and then cautiously approached until he could sniff at the toe of my shoe. A slight grating of my gun barrel against a rock caused him to vanish like a flash, and this time he did not reappear.

Evotomys dawsoni Merriam. Dawson Red-backed Mouse.

Red-backed mice are by far the most abundant mammals in the Yukon region. Although but one specimen was taken at Bennett, and none between there and Fifty-Mile River, in spite of considerable trapping, aside from this they were found all along our route from Skagway to Fort Yukon. The following are the most important localities at which specimens were secured: Skagway, Glacier, Bennett, White Horse Rapids, Lake Lebarge, Rink Rapids, Fort Selkirk, Dawson, Charlie Creek, and Circle. From a study of this series, which numbers over 100 specimens, it appears that all belong to one species, *E. dawsoni*. Its range probably reaches northward almost if not quite to the limit of trees.

Specimens were trapped in all sorts of localities; along cold streams, under logs, in heavy moss, in *Microtus* runways, and among rocks. They abound on the large islands, where they were generally caught in dry, brushy places, in the dead leaves which cover the ground. We occasionally saw them during the day, and often heard them rustling the dead leaves on the ground about us as we lay in our blankets at night. They are the vermin of the miner's larder, and are always to be found about log cabins.



SKULLS OF SCIURUS AND NEOTOMA. (× 1½.)

1. *Sciurus vancouverensis.*
2. *Sciurus hudsonicus petulans.*
3. *Neotoma cinerea drummondi.*
4. *Neotoma saxamans.*

Evotomys dawsoni alascensis (Miller). Tundra Red-backed Mouse.

Evotomys alascensis Miller, Proc. Acad. Nat. Sci. Phila., 1898, 364–367.

The *Evotomys* found at St. Michael has heretofore been compared only with the Asiatic *E. rutilus.* Its closest relationship is really with *E. dawsoni,* with which its range is doubtless continuous. On comparing the series secured at St. Michael with those in the same condition of pelage from Rink Rapids,[1] Northwest Territory, I am unable to find even the slightest difference in color or size. The skull of *alascensis* is slightly characterized by small, narrow molar series, and by nasals which have their posterior end truncate. The palate and audital bullæ are not peculiar. The tail is often thick and bristly in winter pelage and in immature specimens of both *dawsoni* and *alascensis.* From this it appears that *alascensis* may be only a slightly marked subspecies.

The favorite habitat of these mice about St. Michael is in the heaps of broken lava scattered about over the tundra. They are very rarely taken in the *Microtus* runways. They are common in the warehouses, which they seem to enter more readily than other mice of the tundra.

Microtus mordax (Merriam). Long-tailed Vole.

Specimens of this vole were taken at Skagway, Glacier, Bennett, Lake Marsh, Lake Lebarge, Rink Rapids, and near Charlie Village. Specimens from near the coast are almost exactly like those of the interior and all are quite typical of the species. They were found in various environments, but the general habitat of the species was dry places rather than moist. At Glacier and Bennett they were secured on dry, rocky hillsides; at Lake Marsh two specimens were taken in the crevises of some granite rocks; at Lake Lebarge they were taken in the kitchen of a log cabin; at Rink Rapids, in an open, sandy place; and near Charlie Village, on the side of a cut bank, where they had made burrows and runways among the exposed roots of trees. Charlie Village is by far the northernmost locality from which the species has been recorded.

Microtus drummondi (Aud. and Bach.). Drummond Vole.

This is the most common meadow vole of the Yukon region. At Caribou Crossing and Lake Marsh its runways form interminable labyrinths in the level, open stretches of sedge at the margin of the water. It occurs in nearly all moist, grassy places from Caribou Crossing to Fort Yukon. From there it undoubtedly ranges farther on, at least to Nulato, where Dall took several specimens. It is most active during the day, as I easily learned by visiting traps night and morning. Near Fort Yukon I found its runways on recently deposited silt sparsely grown up to *Equisetum*. Its burrows in this soft material were very numerous, and at the entrance to each a little heap of earth in small globular lumps, as if carried in the mouth, was always to be seen.

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[1] No good series of specimens is available from any point nearer Finlayson River, the type locality of *E. dawsoni,* than Rink Rapids. This series is therefore used to represent the species.

Microtus xanthognathus (Leach). Yellow-cheeked Vole.

This fine species was met with only once. A small colony was found on a little stream near Charlie Village, occupying an old log jam, part of which had become embedded in a matrix of sand and mud and overgrown with weeds. Burrows perforated this structure in numerous places, and well-beaten, open runways connected various openings about the protruding logs. The little animals were quite active during the daytime, and as I walked over the logs I occasionally saw one flash from one opening under a log to another and heard sharp little squeaks sounding all about beneath me. A liberal number of traps placed about yielded nine specimens, chiefly immature. The colony was apparently confined to the log jam, as traps set in suitable places but a few yards away secured only *M. drummondi*. Four specimens of this vole collected by Robert Kennicott are in the National Museum, one from the mouth of the Porcupine and three from the Yukon, 200 miles southwest of that point.

Microtus operarius (Nelson). Nelson Vole.

This vole was taken on a small stream about 40 miles above Circle, and a few more were secured between that point and Fort Yukon. It doubtless ranges from there to the coast. Forty-nine specimens were taken at St. Michael. These represent all stages of growth and several phases of color and seem to offer pretty conclusive proof that but one species of *Microtus* occurs at St. Michael. It was found in all moist parts of the tundra, being particularly numerous along the banks of the small ponds in the tall grass and rank, weedy growths.

Fiber spatulatus[1] sp. nov. Northwest Muskrat.

Type from Lake Marsh, Northwest Territory, Canada. No. 98567, U. S. Nat. Mus., Biological Survey Collection, ♀ yg. ad. Collected July 3, 1899, by W. H. Osgood. Original No., 552. (See Plate VI, fig. 4.)

Characters.—Similar in general to *Fiber zibethicus;* size small; color rather dark; skull small; molar teeth very small; nasals short and much expanded anteriorly.

Color.—Similar to *Fiber zibethicus*, but apparently less suffused with fulvous.

Skull.—Similar to that of *Fiber zibethicus* (Plate VI, fig. 3[2]), but smaller; jugals more slender, and but slightly produced dorsally; audital bullæ smaller; molar teeth decidedly smaller; nasals much shortened and widely expanded anteriorly, rapidly becoming compressed posteriorly; angular process of mandible short, blunt, and upturned; condyle narrow and somewhat rounded.

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[1] *Spatulatus*, spatulate, in allusion to the shape of the nasals.

[2] No. 76259, U. S. Nat. Mus., from Wilmington, Mass.

Measurements.—Type (from dry skin): Total length 495; tail vertebræ 170; hind foot 73. Skull of type: Basal length 57; zygomatic breadth 38; length of nasals 21; alveolar length of molar series 14.

Remarks.—Specimens of this species from Ugashik, Fort Kenai, Nushagak, and Nulato, in Alaska, have been examined. Besides these, I find two specimens from Alberta which seem to be referable to it, one from South Edmonton and one from Henry House. These all agree in having very small molar teeth and short, spatulate nasals, characters which are amply sufficient to distinguish the species from all other forms in the genus. The specimens secured by Nelson at St. Michael can not now be found, but they doubtless show the same characters. *Fiber osoyoosensis* has larger teeth and a much longer rostrum than *spatulatus*, so need not be further compared with it. From these facts it appears that *Fiber spatulatus* is the form occupying all of northwest America, and is derived from a form east of the Rocky Mountains rather than from a western one.

Muskrats occur sparingly all along the Yukon, where they find particularly favorable environment about the many small swamp-invested ponds a short distance from the river banks. At St. Michael a few are still found about the open ponds on the tundra.

Synaptomys dalli Merriam. Dall Lemming Mouse.

Lemming mice were taken at the foot of Lake Lebarge, at Rink Rapids, and near the mouth of the Chandindu River. At Lake Lebarge they were found in the long grass at the edge of a small pond; at other localities in cold, boggy places near small streams. The external characters of *S. dalli* have been unknown up to the present time, but, as was to be expected, they are in accordance with the general type so uniform throughout this genus. The color of the upperparts is chiefly raw umber mixed with black; the lower parts are uniform bluish white, and the feet and tail are dusky. The ears are of medium size and partially hidden by long hairs growing from the anterior base; a conspicuous bluish-white side gland is present in the males. The skull of the type of *dalli* is not fully mature and does not agree in all particulars with my specimens from the Upper Yukon. In these the skull is somewhat larger and heavier and the nasals are a trifle longer and more noticeably constricted posteriorly.

Lemmus yukonensis Merriam. Yukon Lemming.

Lemmus yukonensis Merriam, Proc. Wash. Acad. Sci., II, 27, March 14, 1900.

This lemming was found at only two localities—Rink Rapids, where five specimens were secured, and Charlie Creek, where five more were taken. Considerable careful trapping was done at various points between these two places, but no other specimens were secured. At Rink Rapids they were caught about old logs and among dry leaves in places usually frequented by red-backed mice. At Charlie Creek one was caught in a *Microtus* runway and several were secured on the side of a cut bank. On one occasion one was seen running about under a brush heap in midday.

Lemmus alascensis Merriam. Alaska Lemming.

Lemmus alascensis Merriam, Proc. Wash. Acad. Sci., II, 26–27, March 14, 1900.

All efforts to secure this species at St. Michael proved fruitless. I kept large numbers of traps out for more than two weeks and set them in all conceivable locations about the tundra, but failed to catch any lemmings.

Dicrostonyx nelsoni Merriam. Nelson Pied Lemming.

Dicrostonyx nelsoni Merriam, Proc. Wash. Acad. Sci., II, 25–26, March 14, 1900.
Dicrostonyx hudsonius alascensis Stone, Proc. Acad. Nat. Sci. Phila., March 24, 1900, 37–38.

No specimens of this species were taken. Nelson says of it:

> Specimens were brought me by the fur traders from above Fort Yukon and from Nulato, Anvik, and Kotlik, along the course of the Yukon, and also from the Kaviak Peninsula and about Kotzebue Sound. A few were taken near St. Michael, but they were not numerous there. They are more plentiful about Bering Straits than any other district visited by me, if the number of their skins among the native children can be taken as a guide.

Zapus hudsonius alascensis Merriam. Alaska Jumping Mouse.

Three typical specimens of this jumping mouse were taken in a sedgy swamp near the foot of Lake Lebarge. Similar swamps exist near the Yukon, at least as far as Fort Yukon, but I was unable to do any trapping in them. No specimens were taken elsewhere.

Erethizon epixanthus myops Merriam. Alaska Porcupine.

Erethizon epixanthus myops Merriam, Proc. Wash. Acad. Sci., II, 27–28, March 14, 1900.

Porcupines are quite common in all the forest region of Alaska. I noticed signs of them at many places along the Yukon. They were abundant about Glacier, in the White Pass region, and I shot one there one evening as it swayed back and forth in the top of a slender alder. It was eating the leaf buds which were just bursting.

Ochotona collaris (Nelson). Alaska Pika.

Two specimens of an ashy gray *Ochotona* were taken, one at the summit of White Pass, another at the head of Lake Bennett. The species was apparently quite rare at these localities and it was only with considerable difficulty that these individuals were secured. Both are very pale, ashy gray, with pure white underparts, no traces of fulvous, and very indistinct collars. They are in the early spring or left-over winter pelage, and agree quite well with specimens in the same pelage collected in the Chigmit Mountains, near Bristol Bay, by C. L. McKay. The type and topotypes of *O. collaris* are in the summer or post-breeding pelage and present quite a different appearance.

The species apparently occurs in the high mountains throughout Alaska. It was reported to me from the MacMillan Mountains, the Upper Stewart River, the Upper White, and the Upper Tanana. Fragments of a skull were found in an owl pellet picked up by Dr. Bishop near Windy Arm, Lake Tagish. The present record from White Pass is the most southern one. There is suitable country for it farther south, and it will be interesting to trace its range in this direction.

Lepus saliens sp. nov.

Type from Caribou Crossing, between Lake Bennett and Lake Tagish, Northwest Territory, Canada. No. 98956, U. S. Nat. Mus., Biological Survey Collection, ♂ ad. Collected June 26, 1899, by W. H. Osgood. Original No., 504.

Characters.—Similar to *Lepus bairdi*, but more yellowish and less ruddy; dorsal hairs with plumbeous roots; feet nearly white in summer; similar to *L. columbiensis*,[1] but with greater amount of black in dorsal region; feet much lighter; skull similar in general to that of *Lepus a. dalli;* audital bullæ very large.

Color.—Type in *worn spring pelage:* Upperparts mixed black and yellowish buff, with patches of plumbeous under-fur exposed in places; black hairs predominating on rump and middle of back, forming an ill-defined dorsal stripe; outer edge of thighs, outer side of forelegs and pectoral band buff; ears and head, except sides of nose, buff with black hairs sprinkled through; sides of nose gray; ears margined with white; hairs of fore and hind feet plumbeous at base, rufous in central part, and broadly white at tips; general appearance of feet white, lightly mixed with rufous; underparts, except pectoral band, white.

Skull.—Similar to that of *dalli* but somewhat larger; teeth heavier; nasals long, heavy, and very broad anteriorly; audital bullæ very large; palate short; malars rather wide, deeply channeled anteriorly; postorbital and antorbital processes of frontals well developed.

Measurements.—Type (measured from dry skin): Total length 395; hind foot 134; ear from crown 74. Skull of type: Occipitonasal length 77; greatest zygomatic breadth 38; length of nasals 33; greatest width of nasals 17; alveolar length of molar series 15.

Remarks.—The exact relation in which this species stands to *americanus*, *bairdi*, and *columbiensis* is difficult to determine at present. Its light feet point to relationship with *bairdi*, while its dark under color and general buffy appearance are more like *columbiensis*. Its skull is quite distinctive, the large audital bullæ and broad nasals being unequaled in the group. It seems probable that it is a northern form of *bairdi* not related to *columbiensis*, which is nearer to *washingtoni*. There are no specimens available to show whether or not it has any connection with *dalli*, which is the form found on the Lower Yukon. But two specimens were secured—the type, which I shot in a *Lepargyrœa* thicket at Caribou Crossing, and one very young female which Dr. Bishop took in a willow bog near Bennett City. It seems to have been a decidedly 'off year' for rabbits, for these two were the only ones we saw on our entire trip, though numerous signs of their former abundance were seen daily.

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[1] Rhoads, Proc. Acad. Nat. Sci. Phila., 1895, 242–243.

Lepus americanus dalli Merriam. Dall Varying Hare.

Lepus americanus dalli Merriam, Proc. Wash. Acad. Sci., II, 29–30, March 14, 1900.

This rabbit is doubtless abundant at certain times all along the Lower Yukon, but we heard very little of it. It is subject to epidemics and frequently becomes locally extinct, which probably accounts for its scarcity last year.

Lepus othus Merriam. Alaska Arctic Hare.

Lepus othus Merriam, Proc. Wash. Acad. Sci., II, 28, March 14, 1900.

Signs of Arctic hares were occasionally noticed about St. Michael, but we did not see any of the animals. The Eskimos were hunting continually, and brought numbers of ducks and geese to the village to sell, but they brought no rabbits during our stay.

Lynx canadensis mollipilosus Stone. Arctic Lynx.

Lynx canadensis mollipilosus Stone, Proc. Acad. Nat. Sci. Phila., March 24, 1900, 48–49.

The Canada lynx is not as common in the interior of Alaska as might be expected. I saw no signs of it and could obtain only very scanty information as to its occurrence. The police sergeant in charge of the station at the foot of Lake Lebarge told me that the tracks of but one had been seen in that vicinity during the previous winter. Lynx-skin robes are in common use in the country, but the majority of them are imported. This I learned from a trader at Circle, who had several for sale that came from eastern and southern Canada.

Lynx skulls from the following localities are in the National Museum: Tanana River, Russian Mission, Nulato, Andraefski, and mountains near Unalakleet.

Canis occidentalis Richardson. Wolf.

The country along the Yukon is not well suited for wolves, and they are seldom seen there. A prospector showed me the skin of a large gray one from the upper waters of the MacMillan river—the only one I saw on the trip.

Vulpes fulvus (Desmarest)? Red Fox.

Occasional reports of foxes were received all along our route, but no specimens were secured. Owing to their natural sagacity, foxes are doubtless able to hold their own against trappers better than most other fur-bearing animals. Their skins are quite common among traders and natives.

Vulpes hallensis Merriam. Hall Island Fox.

Vulpes hallensis Merriam, Proc. Wash. Acad. Sci., II, 15–16, March 14, 1900.

White fox skins are common among the natives and traders at St. Michael, and could be bought at from $1 to $4 each, according to quality. During our stay there one of the animals was seen on the island, which indicates that they are still far from extermination.

Ursus americanus Pallas. Black Bear.

Black and brown bears are common all along the Yukon. We found them common on the upper river, and Nelson records them as far down as Anvik. We saw tracks very frequently, but owing to the thick forest and underbrush, and the fact that we made no special hunts for them, the animals themselves were rarely observed. A young adult female in glossy black pelage was killed at Glacier by A. G. Maddren, and several others were seen during our stay there. I was told at Lake Lebarge and at White Horse Rapids that brown bears were seen very frequently. At Fort Selkirk I saw skins brought from the Pelly River. Near Charlie Village I saw the skin of a large brown bear that had been killed there shortly before our arrival. One afternoon while sitting in the boat preparing specimens, about 20 miles above Circle, I saw a good-sized black bear walking deliberately across an open space on a hillside a short distance away. We gave chase, but did not see it again. At the mouth of the Tatondu River I saw numerous tracks, and on the border of a stagnant pool found evidences that bruin had been enjoying a mud bath. Moss uprooted by bears in digging for roots was noticed at several places.

Ursus horribilis alascensis Merriam. Alaska Grizzly Bear.

Very little accurate information is obtainable in regard to the grizzly in the Yukon region. It doubtless occurs sparingly all along the river, but miners and prospectors report any large bear as a grizzly, and without doubt often mistake the brown bear for it. There are a number of its skulls from Norton Sound in the Biological Survey collection.

Lutra canadensis (Schreber). American Otter.

The fate of the otter in Alaska is much the same as that of the beaver. There are doubtless a few on some of the smaller streams of the interior and about the Yukon delta, but they are now quite rare in comparison with their former abundance.

Lutreola vison ingens subsp. nov. Alaska Mink.

Type (skull) from Fort Yukon, Alaska. No. 6530, U. S. Nat. Mus., ♂ ad., old. Collected by Robert Kennicott. (See Plate VI, fig. 2.)

Characters.—Size largest of North American mink; similar to *L. v. energumenos*, but lighter in color and very much larger; skull and teeth very large and heavy.

Color.—Similar in general to *Lutreola v. energumenos*, but paler.

Skull.—Very large, angular, and ridged; rostrum very wide; braincase relatively shallow and very wide; zygomata heavy; audital bullæ large and relatively wide; dentition heavy. (Compare with skull of *Lutreola v. energumenos*, Plate VI, fig. 1.[1])

Measurements.—No. 13880, U. S. National Museum, St. Michael, Alaska (from dry skin): Total length 720; tail vertebræ 180; hind foot 75. Skull of type: Occipitonasal length 69; zygomatic breadth 47; mastoid breadth 41; breadth across postorbital processes 23; length of audital bulla 17. Average of five adults: Occipitonasal length 44.5; mastoid breadth 39.5; breadth across postorbital processes 21; length of audital bulla 17.5.

Remarks.—The large size of the Alaska mink has been noted by various authors,[2] but each has dismissed the subject by concluding that it is the natural result of the animal's northern range, and the form has remained unnamed, while less marked forms from other localities have been recognized. The largest mink previously described is *L. v. energumenos*, which is very much smaller than *ingens* and also averages much darker.

The minks of the Yukon region are caught mostly on the tributary streams, and, as stated by Nelson, are very abundant in the area between the deltas of the Yukon and the Kuskokwim. Along the Yukon itself our party did not see any, and very few signs of them were observed. Their skins were seldom seen among the Indians and Eskimos. They were reported, however, from the Porcupine, Koyukuk, Tanana, and various other streams tributary to the Yukon, and without doubt occur in suitable places all over Alaska.

Putorius arcticus Merriam. Tundra Weasel.

Putorius arcticus Merriam, N. Am. Fauna No. 11, 15, June, 1896.
Putorius cicognani richardsoni Merriam, *l. c.*, 11–12 (part).

Three immature specimens of this weasel were taken at St. Michael. They were caught in traps baited with sandpipers and set among the lava rocks along the shore. Several specimens which were also secured at St. Michael by Nelson and Turner are in the National Museum. Besides these I find specimens from Nulato, Fort Yukon, and Fort Reliance, which gives the species a more extensive range in the interior than it has been supposed to have. Most of these specimens are

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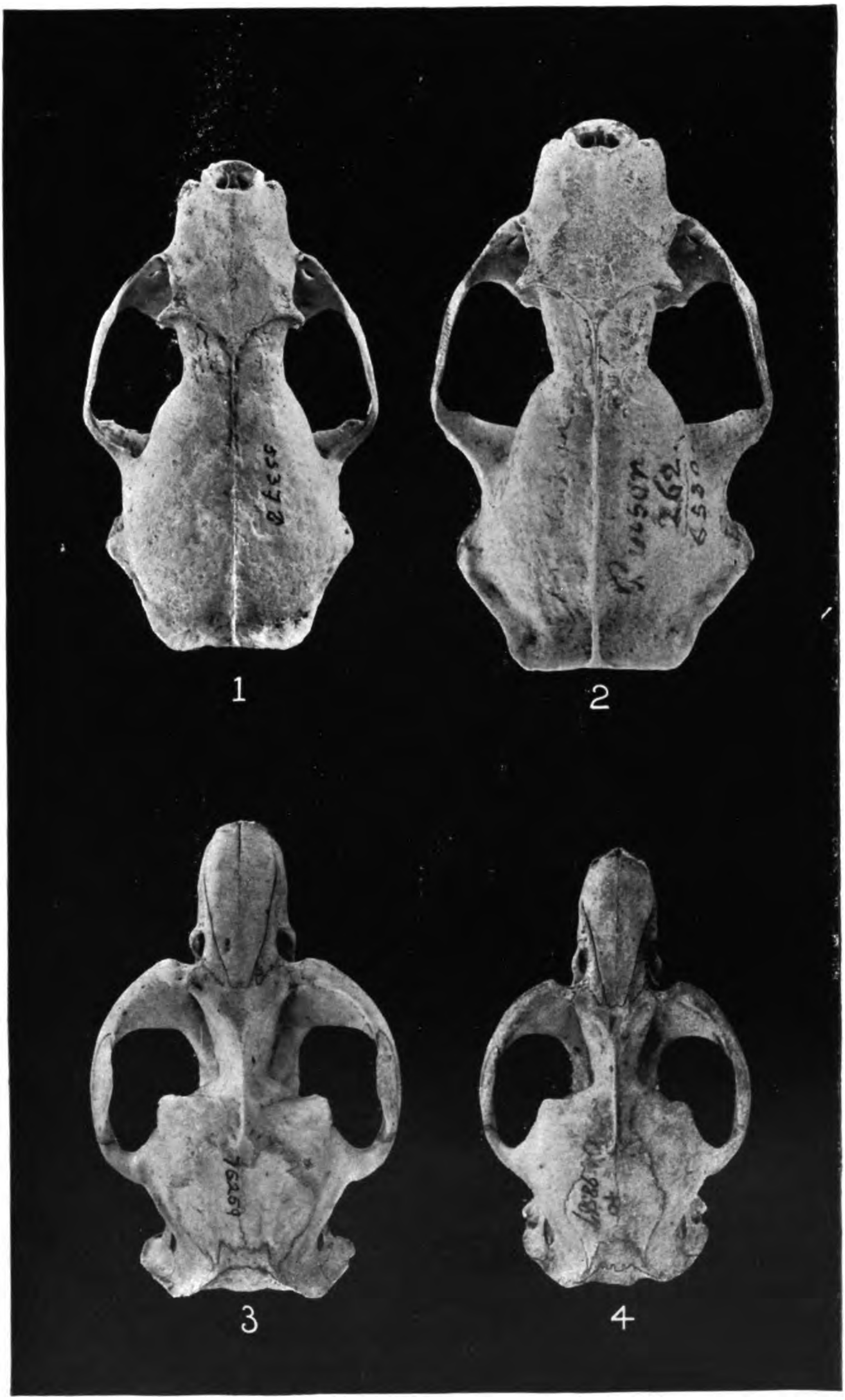
[1] No. 5537, Bangs collection, from Sumas, B. C.

[2] See Allen, Bull. U. S. Geol. and Geog. Survey Terr., II, 327–328, 1876.



SKULLS OF LUTREOLA AND FIBER. (Natural size.)

1. *Lutreola vison energumenos.*
2. *Lutreola vison ingens.*
3. *Fiber zibethicus.*
4. *Fiber spatulatus.*

imperfect, but enough skulls are now at hand to show conclusively that all the Yukon specimens heretofore identified as *richardsoni* are really practically identical with *P. arcticus* from Point Barrow.

Putorius cicognani alascensis (Merriam). Juneau Weasel.

A single immature specimen taken 20 miles below Fort Selkirk is referred to this form. Its skull is rather large and indicates a possible intergradation with *P. arcticus;* otherwise it agrees with *alascensis.*

Putorius rixosus eskimo Stone. Alaska Least Weasel.

Putorius rixosus eskimo Stone, Proc. Acad. Nat. Sci. Phila., March 24, 1900, 44–45.

No specimens of this rare weasel were obtained. There are three imperfect specimens in the National Museum, two from St. Michael and one from Fort Reliance. Besides these the only ones recorded are the type and four topotypes from Point Barrow, Alaska, and the specimen mentioned by Stone (loc. cit.) from Bethel, Kuskokwim River, Alaska.

Mustela americana actuosa subsp. nov. Alaska Marten.

Type (skull) from Fort Yukon, Alaska. No. 6043, U. S. Nat. Mus., ♂ ad., old. Collected by Robert Kennicott. (See Plate VII, fig. 2.)

Characters.—Similar to *M. brumalis*, but larger; cranial and dental characters distinctive.

Color.—(Topotype, No. 6416, U.S.N.M., ♂ ad.): Posterior half of upperparts pale ochraceous buff, shoulders and anterior part of upperparts gradually becoming grayish; entire upperparts, except head, overlaid with coarse brown hairs; head, including cheeks and throat, pale grayish-white lightly mixed with brown, especially on nose and chin; inside and edges of ears whitish, outside and bases of ears brown; underparts similar to upperparts, but darker and more brownish on chest; an irregular patch of creamy buff mixed with white on chest; legs and feet dark brown, front of legs with mixture of gray hairs; tail brown, somewhat darker at tip, and with a slight mixture of gray hairs.

Skull.—Similar to that of *M. brumalis* (Plate VII, fig. 1[1]), but somewhat larger; relatively longer and narrower; interorbital space slightly narrower; audital bullæ very much larger and longer; dentition relatively much weaker; last upper molar decidedly smaller.

Measurements.—Average of four adult male topotypes measured in the flesh by the collector: Total length 26.22 inches (665 mm.); tail vertebræ 8.08 inches (223 mm.); hind foot 4.36 inches (109 mm.). Skull of type: Occipitonasal length 85; greatest zygomatic breadth 55; breadth across postorbital processes 24; palatal length 44; length of audital bullæ 19.

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[1] Type No. 7417, Bangs collection, from Okak, Labrador.

Remarks.—This form is the largest of the subspecies of *Mustela americana*. *M. brumalis* is also large, but does not equal *actuosa*, and notwithstanding its smaller size has heavier dentition. The enormous audital bullæ of *actuosa* are not equaled by those of any other member of the group. The skulls of *americana* (Plate VII, fig. 3[1]) and *caurina* are so very much smaller than those of *brumalis* and *actuosa* that they do not need to be closely compared. In a good series of *actuosa* from Fort Yukon and Fort McPherson the characters are very constant. A large number of skins from these localities present very little variation, and nearly all are quite light colored like the one described above. The marten is still the commonest fur-bearing animal of Alaska, notwithstanding the hundreds of thousands that have already been taken. Trappers are always confident of a harvest of martens whether other animals are abundant or not.

Mustela pennanti Erxleben. Fisher.

Dr. Elliott Coues[2] states that he has examined specimens of the fisher from Alaska, but does not give the exact locality. At present no specimens are at hand to corroborate this record, but there is little doubt that the animal occurs along the Upper Yukon, as it is known from similar latitudes to the eastward. It was not met with by our party, and I received no reliable information in regard to it.

Gulo luscus (Linnæus). Wolverine.

Wolverines seem to be quite common in the Yukon region. They were often reported, and I saw a number of skins among the natives on the lower river. One was said to have been trapped at Tagish in the winter of 1898, and others were seen in the vicinity. They are seen frequently about Lake Lebarge in winter, and trappers from the MacMillan River say they are abundant in that region.

Sorex personatus streatori Merriam. Streator Shrew.

Specimens of this shrew were secured as follows: Haines 1, Skagway 6, Glacier 1, Bennett 3, Caribou Crossing 2, Lake Lebarge 1, 50 miles below Fort Selkirk 1, mouth of Chandindu River 1, and 40 miles above Circle 1. Although the conditions along the Yukon seem to be ideal for shrews, I was unable to secure many specimens, and could only conclude that they were not common there, for the same methods of trapping were much more successful in the coast regions.

Sorex personatus arcticus Merriam. Arctic Shrew.

Sorex personatus arcticus Merriam, Proc. Wash. Acad. Sci., II, 17, Mar. 14, 1900.

Twenty specimens were taken at St. Michael. They occur throughout the tundra in much the same situations as *S. tundrensis*, but were also found in the lava heaps and along high banks near the coast.

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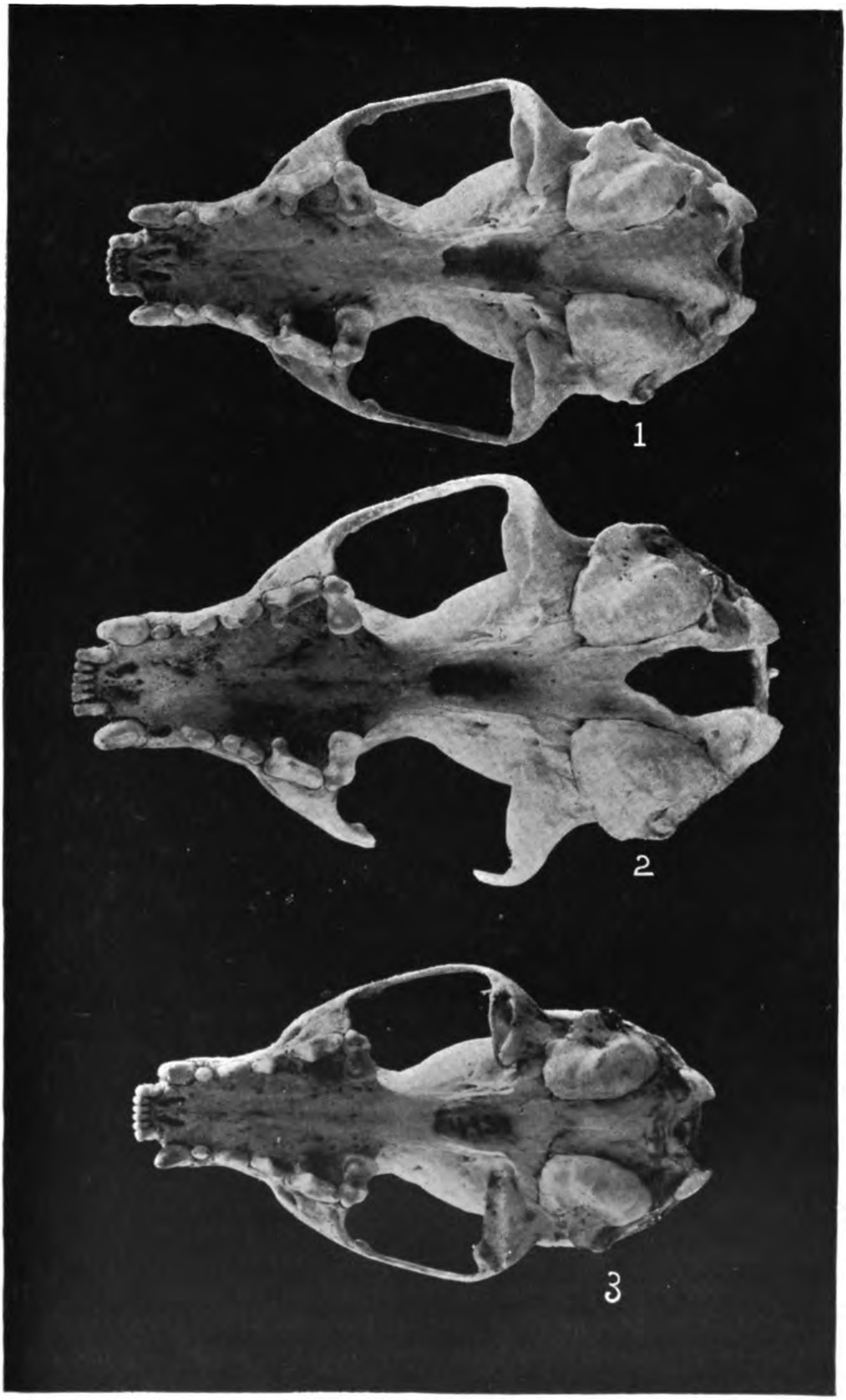
[1] No. 4934, Merriam collection, from the Adirondacks, New York.

[2] Fur-bearing Animals, 69, 1877.



SKULLS OF MUSTELA. (Natural size.)

1. *Mustela americana brumalis.* 2. *Mustela americana actuosa.* 3. *Mustela americana.*

Sorex obscurus Merriam. Mountain Shrew.

Two specimens were caught under tufts of grass on a rocky hillside at Bennett. This locality is much farther north than any from which this species has been previously recorded.

Sorex tundrensis Merriam. Tundra Shrew.

Sorex tundrensis Merriam. Proc. Wash. Acad. Sci., II, 16–17, March 14, 1900.

Eighteen specimens of this pretty shrew were taken at St. Michael. They were found in various parts of the tundra, but seemed to be in small localized colonies. About certain small ponds nearly all the shrews caught were of this species, while but a short distance away all were *arcticus*. A single imperfect specimen collected by Kennicott near Fort Yukon is in the National Museum. In size it does not differ from typical *tundrensis*, but in color it is somewhat darker, thus indicating a possible intergradation with *richardsoni*.

Myotis lucifugus (Le Conte). Little Brown Bat.

Bats were first seen at Caribou Crossing, and from that point were occasionally noticed at various places to our camp, 50 miles below Fort Selkirk, where they were last seen. Turner mentions their reported occurrence as far down as Fort Yukon and Nulato. In June and July we generally found them flying from 10 to 11.30 p. m., and sometimes even later. Two specimens only were secured. These are somewhat grayer and less glossy than specimens from the eastern United States.

BIRDS OF THE YUKON REGION, WITH NOTES ON OTHER SPECIES.

By Louis B. Bishop, M. D.

INTRODUCTION.

In preparing the ornithological part of this report I have thought it advisable to note as far as possible all species met with from the time we passed Dixon Entrance, northward bound, May 28, until we reached Cape Scott on the return trip, October 12, for the reason that articles on Alaska birds are not yet so numerous as to make such notes worthless. It was of course impossible to obtain specimens of waterfowl seen from the decks of steamers; therefore when specific identification was not positive I have referred genera seen to the species which previous observers—especially E. W. Nelson and William Palmer—have found most common in the waters visited.

Nowhere did we see the vast colonies of water birds which others have met with in Alaskan waters, probably because most of these birds had left their summer homes in Bering Sea when we passed in October; but various migrants were common in the Inside Passage in May, geese and ducks on the Lower Yukon in August, and waterfowl of many species in Akutan Pass in October.

The region from Skagway, at the head of Lynn Canal, to Circle, on the Yukon, was the scene of most of our work; and as very little was known of it ornithologically I have mentioned in my annotated list every occasion of our observation of all except the commonest species. Ornithologists, in referring to the Upper Yukon, include, as a rule, only that part of the river which lies between Dawson and Nulato; hence the avifauna of its head waters was with us largely a matter of conjecture. George G. Cantwell[1] mentions species he saw about the lakes; but his experience was in many ways so different from ours that, while crediting him with the first records for species which we also found, I have omitted others which we did not find and for which he may have mistaken closely allied birds.

The country we traversed between Skagway and Circle divides itself into three quite distinct faunal districts. The coast of Southeast Alaska belongs to the 'Sitkan district' of Nelson, White Pass Summit and the heights above Glacier belong to the Arctic-Alpine zone, and the Yukon Valley belongs to the Canadian and Hudsonian zones. In the last the Canadian element is most pronounced in the lake region, with a very slight infusion of Sitkan forms, the strictly Hudsonian species increasing and the others decreasing as the Yukon winds north toward Fort Yukon. Beyond this point Hudsonian forms predominate, giving place to Arctic where the Yukon loses its identity in the tundra of the delta. The Upper Yukon Valley may be divided faunally at Fort Selkirk, where the Pelly from the Rocky Mountains and the Lewes from the Coast Range unite to form the Yukon proper, 15 species of land and shore birds occurring above this point which have not been found between there and Fort Yukon, and 12 having been recorded between the Pelly and Fort Yukon which have not been taken above. Of the 128 species and subspecies found between Dixon Entrance and Fort Yukon, 22 per cent were common to the coast of southeast Alaska and the Yukon Valley, 19 per cent confined to the coast, 55 per cent to the Yukon Valley, and 4 per cent found only on White Pass Summit and at similar altitudes.

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[1] Birds of the Yukon Trail <Osprey, III, 25, Oct., 1898.

The avifauna of southeastern Alaska is already fairly well known, and the twelve days spent at Haines, Skagway, and Glacier resulted chiefly in extending the ranges of a few species, though the barn swallow proved to be the subspecies recently reinstated by Mr. Palmer, the myrtle warbler that lately described by Mr. McGregor, and the wood pewee an unrecognized form. Of the 52 species found between Dixon Entrance and Glacier, 2—*Colaptes auratus luteus* and *Merula migratoria*—were eastern, 8 Alaskan, 25 Pacific coast, and 17 common to northern North America. At Haines, which is situated on a narrow and for the most part heavily wooded peninsula, birds, although not common, were more numerous than they were either at Skagway, which is in a narrow cliff-bordered valley at the head of Lynn Canal, or at Glacier, 14 miles from Skagway, 1,870 feet higher, and surrounded by deep spruce woods and alder thickets. We found in the avifauna of Glacier a slight but decided difference from that of the tide-water level of Lynn Canal, *Junco hyemalis connectens* replacing *J. h. oregonus*, and *Wilsonia pusilla pileolata* replacing *Helminthophila celata lutescens*, while *Melospiza melodia rufina* and *Merula migratoria* were absent.

Among the thickets of alpine hemlock growing with moss and heather between the granite rocks of White Pass Summit and the heights above Glacier we found *Zonotrichia coronata* and *Anthus pensilvanicus* common, and *Lagopus rupestris*, *L. leucurus*, *Leucosticte tephrocotis littoralis* and *Sayornis saya yukonensis* in smaller numbers. *Sayornis s. yukonensis* reached the Yukon level at Fort Selkirk, and *Anthus pensilvanicus* at Circle, but the others were not seen again.

To one accustomed to the orchards, fields, and forests of Connecticut, the duck marshes of North Dakota, or even the balsam thickets of northern New England, the Yukon Valley seems wanting in bird life—not the center of abundance of its avifauna, but rather a deposit for the overflow from more favored regions. There are exceptions to this rule, notably wandering flocks of crossbills, the colonies of bank swallows of Fifty-Mile and Thirty-Mile rivers and the Yukon proper, the spotted sandpipers that continually flitted across our bow, the intermediate sparrows and juncos that seldom failed to greet us as we stepped ashore, and the Alma thrushes, whose songs sounded all night, wherever we happened to camp. Bird life is fairly abundant, too, in certain favored places such as Log Cabin, Caribou Crossing, the swampy shores of Lake Marsh, and the ponds and level country at the lower end of Lake Lebarge. Near Miles Canyon I noticed 23 species on July 11, but individuals of each, with the exception of bank swallows, were few. In the entire Upper Yukon Valley breeding colonies of shore and water birds were conspicuously absent. The precipitous shores of the lakes, the comparative absence of islands, the swift current of the Yukon, and its high banks cut by narrow, wooded valleys, are a sufficient explanation of this; and I can not believe that either geese, ducks, or shore birds ever bred abundantly in most of the region visited, though their number has doubtless been reduced in recent years.

In the Yukon flats the condition changes, and no doubt many of these birds find a summer home in the ponds a few miles back from the river, as they do at the foot of Lake Lebarge; but these we had no opportunity of visiting. Our study of the bird life of the Yukon was chiefly confined to what could be seen or heard from our boat or on the banks in the immediate vicinity of camping places. From the lakes to the Alaska boundary snow-capped peaks were absent, and no species were found that did not also occur upon the banks of the river, although we climbed hills, visited deep woods, and ascended small streams for some distance. As we proceeded north, however, several birds were found at lower altitudes than those at which they had been already noted. Away from the river, birds were rarer than immediately upon its banks.

We learned little regarding the Upper Yukon as a migratory highway for species breeding farther north, though we heard that thousands of geese and ducks passed Lower Lebarge in the spring. It was too late for the spring migration, and the southward movement of ducks and geese had hardly begun on August 20, when we left Circle. The fall migration of the Limicolæ should have been well under way at this date, but very few of these birds were observed. If they do pass in large numbers they must frequent the ponds back from the river. Several times at Circle, I walked a long distance over the sand flats left bare by the falling Yukon without seeing any shore birds, or anything on which they could feed. This was very different from the constantly passing flocks I saw on the Yukon Delta August 27–28, and the abundance of Limicolæ at St. Michael in September. The smaller land birds we often saw late in July and in August. They were usually in family parties, and most of them seemed to be traveling up the river. At Circle the intermediate sparrow, western tree sparrow, and western savanna sparrow were abundant, and were evidently migrating August 19–20.

Forty-two species of migratory birds, exclusive of those possessing a continental range, certainly occur as summer residents in the Yukon Basin above Fort Yukon. Of these, 13 (31 per cent) have their center of distribution in eastern North America, 14 (33 per cent) near the Pacific coast, and 15 (36 per cent) in western North America not far from the Rocky Mountains. The eastern birds reach the Yukon through the Rocky Mountains. Some of these, such as *Chordeiles virginianus*, were found only above the Tatchun River; others, as *Empidonax t. alnorum*, were absent above the Pelly and common from there to Fort Yukon; others, as *Wilsonia pusilla*, were not found above the Chandindu River; others, as *Helminthophila peregrina* were each found at a single place, while still others, as *Junco hyemalis* and *Merula migratoria*, were regularly distributed along the river. The Pacific coast forms probably all reach the Yukon over the Alaska coast range. These disappear as one goes north, *Hylocichla aonalaschkæ* extending through Lake Bennett, *Wilsonia p. pileolata* to Lake Marsh, *Dendroica townsendi* to Lake Lebarge, *Myadestes townsendi* to Dawson, and *Tachycineta thalassina* to Circle. Last and most important in number of species, abundance of individuals, and regularity of distribution are birds which breed in the Yukon Valley and spend the winter in the western United States, as *Zonotrichia l. gambeli*, *Spizella s. arizonæ*, and the small *Ammodramus s. alaudinus* of the Yukon lakes, and those which probably enter by the mouth of the Yukon, as the large *Ammodramus s. alaudinus*, found below Alaska boundary, and *Seiurus n. notabilis*, first met near Dawson.

In coloring, Yukon birds, especially in juvenile plumage, show a strong tendency to replace the buff-ochraceous markings of Eastern forms by white, cream color, and gray. *Canachites c. osgoodi*, *Parus h. evura*, and *Hylocichla u. alma* are good examples of this characteristic.

I take this opportunity to express my hearty thanks to Dr. Merriam for the privilege of visiting Alaska as a member of the Biological Survey party, of writing this report, and of using the collection of the Biological Survey in its preparation; also to Mr. Osgood and Mr. Oberholser of the Biological Survey for aid in determining species. I am also greatly indebted to Mr. Robert Ridgway and Dr. Charles W. Richmond for the opportunity of studying the collection of the

United States National Museum and for much valuable assistance; to Dr. J. A. Allen and Mr. F. M. Chapman for the hours which I spent with the birds in the American Museum of Natural History; to Mr. William Brewster for the courtesy of allowing me to compare my specimens with those in his valuable collection, and to Mr. Walter Deane for much help in this study.

CLASSIFIED LISTS OF SPECIES.

NEW SUBSPECIES.

Canachites canadensis osgoodi.
Sayornis saya yukonensis.
Contopus richardsoni saturatus.

SPECIES NOT HITHERTO RECORDED FROM WESTERN NORTH AMERICA.

Haliæetus albicilla.

SPECIES NOT HITHERTO RECORDED FROM SOUTHEASTERN ALASKA.

Æchmophorus occidentalis.
Xema sabinii.
Lagopus leucurus.
Picoides americanus alascensis.
Contopus richardsoni saturatus.
Empidonax hammondi.
Junco hyemalis connectens.
Sitta canadensis.
Merula migratoria.

SPECIES NOT HITHERTO RECORDED FROM UNALASKA.

Larus philadelphia.
Tringa maculata.
Tringa acuminata.
Loxia curvirostra minor.

SPECIES NOT HITHERTO RECORDED FROM THE PRIBILOF ISLANDS.

Larus philadelphia.
Tringa acuminata.
? Arenaria melanocephala.

SPECIES NOT HITHERTO RECORDED FROM ST. MICHAEL.

Calidris arenaria.

SPECIES NOT HITHERTO RECORDED FROM THE YUKON ABOVE FORT YUKON.

Tringa bairdi.
Symphemia semipalmata inornata.
Buteo borealis calurus.
Falco sparverius.
? Megascops asio kennicotti.
? Dryobates villosus hyloscopus.
Contopus borealis.
Contopus richardsoni saturatus.
Empidonax trailli alnorum.
Empidonax hammondi.
Spinus pinus.
Spizella socialis arizonæ.
Passerella iliaca.
Helminthophila peregrina.
Dendroica townsendi.
Wilsonia pusilla pileolata.
Sitta canadensis.
Hylocichla aonalaschkæ.
Hylocichla aonalaschkæ pallasi.
Saxicola œnanthe.

LIST OF SPECIES KNOWN FROM THE YUKON BASIN.

Colymbus holbœlli.
Colymbus auritus.
Gavia imber.
Gavia arctica.
Gavia lumme.
Stercorarius pomarinus.[1]
Stercorarius parasiticus.[1]
Stercorarius longicaudus.[1]

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[1] Known only from Fort Yukon or below.

Rissa tridactyla pollicaris.[1]
Larus barrovianus.[1]
Larus argentatus smithsonianus.
Larus vegæ.[1]
Larus brachyrhynchus.
Larus philadelphia.
Xema sabinii.[1]
Sterna caspia.[1]
Sterna paradisæa.
Sterna aleutica.[1]
Hydrochelidon nigra surinamensis.[1]
Phalacrocorax pelagicus robustus.[1]
Merganser americanus.
Merganser serrator.[1]
Anas boschas.
Mareca americana.
Nettion carolinensis.
Querquedula discors.[1]
Spatula clypeata.
Dafila acuta.
Aythya vallisneria.[1]
Aythya marila.
Aythya affinis.
Clangula clangula americana.
Clangula islandica.
Charitonetta albeola.
Harelda hyemalis.
Histrionicus histrionicus.
Arctonetta fischeri.[1]
Somateria v-nigra.[1]
Somateria spectabilis.[1]
Oidemia americana.[1]
Oidemia deglandi.
Oidemia perspicillata.
Chen hyperborea.[1]
Anser albifrons gambeli.[1]
Branta canadensis hutchinsi.
Branta canadensis minima.
Branta nigricans.[1]
Philacte canagica.[1]
Olor columbianus.[1]
Olor buccinator.[1]
Grus canadensis.
Fulica americana.[1]
Crymophilus fulicarius.[1]
Phalaropus lobatus.
Gallinago delicata.
Macrorhamphus scolopaceus.[1]
Tringa canutus.[1]
Tringa couesi.[1]
Tringa maculata.
Tringa bairdi.
Tringa minutilla.
Tringa alpina pacifica.
Ereunetes occidentalis.[1]
Calidris arenaria.[1]
Limosa lapponica baueri.[1]
Limosa hæmastica.[1]
Totanus flavipes.
Helodromas solitarius cinnamomeus.
Heteractitis incanus.[1]
Bartramia longicauda.[1]
Symphemia semipalmata inornata.[2]
Tryngites subruficollis [1]
Actitis macularia.
Numenius hudsonicus.
Numenius borealis.[1]
Squatarola squatarola.
Charadrius dominicus.
Charadrius dominicus fulvus.[1]
Ægialitis semipalmata.
Arenaria interpres.[1]
Arenaria melanocephala.[1]
Canachites canadensis osgoodi.
Bonasa umbellus umbelloides.
Lagopus lagopus.
Lagopus rupestris.
Pediœcetes phasianellus columbianus.[1]
Circus hudsonius.
Accipiter velox.
Accipiter atricapillus.
Buteo borealis calurus.[2]
Buteo swainsoni.[1]
Archibuteo lagopus.[1]
Haliæetus leucocephalus alascanus.
Falco rusticolus gyrfalco.
Falco peregrinus anatum.
Falco columbarius.
Falco columbarius richardsoni.[2]
Falco sparverius.[2]
Pandion haliaëtus carolinensis.[1]
Asio accipitrinus.[1]
Scotiaptex cinerea.
Scotiaptex cinerea lapponica.[1]
Nyctala tengmalmi richardsoni.
?Megascops asio kennicotti.[2]
Bubo virginianus pallescens.
Nyctea nyctea.[1]
Surnia ulula caparoch.
Ceryle alcyon.
Dryobates villosus leucomelas.
?Dryobates villosus hyloscopus.[2]

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[1] Known only from Fort Yukon or below.
[2] Known only above Fort Yukon.

Dryobates pubescens nelsoni.
Picoides arcticus.
Picoides americanus alascensis.
Colaptes auratus luteus.
Chordeiles virginianus.[2]
Selasphorus rufus.[2]
Sayornis saya yukonensis.[2]
Contopus borealis.
Contopus richardsoni saturatus.[2]
Empidonax trailli.[1]
Empidonax trailli alnorum.[2]
Empidonax hammondi.[2]
Otocoris alpestris leucolæma.
Pica pica hudsonica.
Perisoreus canadensis fumifrons.
Corvus corax principalis.
Scolecophagus carolinus.
Pinicola enucleator alascensis.
Pyrrhula cassini.[1]
Loxia leucoptera.
Acanthis hornemanni exilipes.
Acanthis linaria.
Spinus pinus.[2]
Passerina nivalis.
Calcarius lapponicus alascensis.
Calcarius pictus.[1]
Ammodramus sandwichensis alaudinus.
Zonotrichia leucophrys gambeli.
Zonotrichia coronata.
Spizella monticola ochracea.
Spizella socialis arizonæ.[2]
Junco hyemalis.
Melospiza lincolni.
Passerella iliaca.
Petrochelidon lunifrons.
Hirundo erythrogastra unalaschkensis.
Tachycineta bicolor.
Tachycineta thalassina.[2]
Clivicola riparia.
Ampelis garrulus.
Lanius borealis.
Helminthophila celata.
Helminthophila peregrina.[2]
Dendroica æstiva rubiginosa.
Dendroica coronata hooveri.
Dendroica striata.
Dendroica townsendi.[2]
Seiurus aurocapillus.[1]
Seiurus noveboracensis notabilis.
Wilsonia pusilla.
Wilsonia pusilla pileolata.[2]
Budytes flavus leucostriatus.[1]
Anthus pensilvanicus.
Cinclus mexicanus.
Sitta canadensis.[2]
Parus atricapillus septentrionalis.
Parus cinctus alascensis.[1]
Parus hudsonicus evura.
Phyllopseustes borealis.[1]
Regulus calendula.
Myadestes townsendi.[2]
Hylocichla aliciæ.
Hylocichla ustulata almæ.
Hylocichla aonalaschkæ.[2]
Hylocichla aonalaschkæ pallasi.[2]
Merula migratoria.
Hesperocichla nævia.
Saxicola œnanthe.
Sialia arctica.[2]

SPECIES WHOSE OCCURRENCE ON THE YUKON IS DOUBTFUL.

Chaulelasmus streperus.
Eniconetta stelleri.
Branta canadensis.
Macrorhamphus griseus.
Aquila chrysaëtos.
Nucifraga columbiana.
Loxia curvirostra minor.
Motacilla ocularis.

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[1] Known only from Fort Yukon or below.

[2] Known only above Fort Yukon.

SPECIES AND SUBSPECIES OCCURRING IN THE YUKON BASIN AND HAVING THEIR CENTER OF ABUNDANCE DURING THE BREEDING SEASON IN ALASKA AND BERING SEA.

Rissa tridactyla pollicaris.[1]
Larus barrovianus.[1]
Larus vegæ.[1]
Larus brachyrhynchus.
Sterna aleutica.[1]
Phalacrocorax pelagicus robustus.[1]
Arctonetta fischeri.[1]
Somateria v-nigra.[1]
Chen hyperborea.[2]
Branta canadensis minima.
Branta nigricans.[2]
Philacte canagica.[1]
Grus canadensis.[2]
Macrorhampus scolopaceus.
Tringa couesi.[2]
Ereunetes occidentalis.
Heteractitis incanus.
Arenaria melanocephala.
Canachites canadensis osgoodi.
Haliæetus leucocephalus alascanus.
? Megascops asio kennicotti.
Picoides americanus alascensis.
Sayornis saya yukonensis.
Contopus richardsoni saturatus.
Perisoreus canadensis fumifrons.
Pinicola enucleator alascensis.
Leucosticte tephrocotis littoralis.
Calcarius lapponicus alascensis.
Hirundo erythrogastra unalaschkensis.
Dendroica æstiva rubiginosa.
Dendroica coronata hooveri.
Parus cinctus alascensis.
Parus hudsonicus evura.
Hylocichla ustulata almæ.
Hesperocichla nævia.

Of these 35 forms, 1 is a subspecies of an Asiatic bird, 5 are chiefly confined to Bering Sea, 2 range in winter to the western Pacific, 7 are resident subspecies of northern North American birds, and the remaining 20 pass in winter to the western United States or beyond.

EASTERN NORTH AMERICAN SPECIES FOUND IN THE YUKON BASIN.

Limosa hæmastica.
Numenius borealis.
Accipiter atricapillus.
Falco sparverius.
Colaptes auratus luteus.
Chordeiles virginianus.
Empidonax trailli alnorum.
Junco hyemalis.
Passerella iliaca.
Helminthophila celata.
Helminthophila peregrina.
Dendroica striata.
Seiurus aurocapillus.
Wilsonia pusilla.
Hylocichla aliciæ.
Hylocichla aonalaschkæ pallasi.
Merula migratoria.

WESTERN NORTH AMERICAN SPECIES FOUND IN THE YUKON BASIN.

Anser albifrons gambeli.
Branta canadensis hutchinsi.
Olor buccinator.
Symphemia semipalmata inornata.
Bonasa umbellus umbelloides.
Pediœcetes phasianellus columbianus.
Buteo borealis calurus.
Buteo swainsoni.
Falco columbarius richardsoni.
Bubo virginianus pallescens.
? Dryobates villosus hyloscopus.
Picoides americanus alascensis.
Selasphorus rufus.
Empidonax traillí.
Empidonax hammondi.
Otocoris alpestris leucolæma.
Pica pica hudsonica.
Calcarius pictus.
Ammodramus sandwichensis alaudinus.
Zonotrichia leucophrys gambeli.
Spizella monticola ochracea.
Spizella socialis arizonæ.
Seiurus noveboracensis notabilis.
Cinclus mexicanus.
Parus atricapillus septentrionalis.
Myadestes townsendi.
Sialia arctica.

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[1] Reported only from the Yukon Delta.
[2] Known only as migrants.

AMERICAN PACIFIC COAST SPECIES FOUND IN THE YUKON BASIN.

Helodromas solitarius cinnamomeus.
Tachycineta thalassina.
Zonotrichia coronata.
Dendroica townsendi.
Wilsonia pusilla pileolata.
Hylocichla aonalaschkæ.

ASIATIC AND PACIFIC SPECIES FOUND IN THE YUKON BASIN.

Limosa lapponica baueri.[1]
Charadrius dominicus fulvus.[1]
Archibuteo lagopus.
Scotiaptex cinerea lapponica.[1]
Pyrrhula cassini.
Budytes flavus leucostriatus.[1]
Phyllopseustes borealis.[1]

MIGRATORY SPECIES NOT COMMON TO NORTHERN NORTH AMERICA FOUND DURING THE BREEDING SEASON IN THE YUKON BASIN ABOVE FORT YUKON.

Eastern species.

Accipiter atricapillus.
Falco sparverius.
Colaptes auratus luteus.
Chordeiles virginianus.
Empidonax trailli alnorum.
Junco hyemalis.
? Passerella iliaca.
Helminthophila celata.
Helminthophila peregrina.
Dendroica striata.
Wilsonia pusilla.
Hylocichla aliciæ.
Hylocichla aonalaschkæ pallasi.
Merula migratoria.

Western species.

Branta canadensis hutchinsi.
? Grus canadensis.
Symphemia semipalmata inornata.
Buteo borealis calurus.
? Otocoris alpestris leucolæma.
Pica pica hudsonica.
? Calcarius lapponicus alascensis.
Ammodramus sandwichensis alaudinus.
Zonotrichia leucophrys gambeli.
Falco columbarius richardsoni.
Selasphorus rufus.
Sayornis saya yukonensis.
Empidonax hammondi.
Spizella monticola ochracea.
Spizella socialis arizonæ.
Seiurus noveboracensis notabilis.
Myadestes townsendi.
Hylocichla ustulata almæ.
Sialia arctica.

Pacific coast species.

Larus brachyrhynchus.
Helodromas solitarius cinnamomeus.
Leucosticte tephrocotis littoralis.
Zonotrichia coronata.
Hirundo erythrogastra unalaschkensis.
Tachycineta thalassina.
Contopus richardsoni saturatus.
Dendroica æstiva rubiginosa.
Dendroica coronata hooveri.
Dendroica townsendi.
Wilsonia pusilla pileolata.
Hylocichla aonalaschkæ.
Hesperocichla nævia.

SPECIES OCCURRING ON THE COAST OF SOUTHEAST ALASKA AND IN THE YUKON VALLEY.

Gavia imber.
Larus philadelphia.
Anas boschas.
Histrionicus histrionicus.
Oidemia deglandi.
Oidemia perspicillata.
Phalaropus lobatus.
Actitis macularia.
Haliæetus leucocephalus alascanus.
Picoides americanus alascensis.

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[1] Known only from the Yukon Delta.

Colaptes auratus luteus.
Selasphorus rufus.
Contopus richardsoni saturatus.
Empidonax hammondi.
Sterna paradisæa.
Corvus corax principalis.
Ammodramus sandwichensis alaudinus.
Spizella monticola ochracea.
Hirundo erythrogastra unalaschkensis.
Tachycineta bicolor.
Dendroica coronata hooveri.
Dendroica townsendi.
Wilsonia pusilla pileolata.
Anthus pensilvanicus.
Sitta canadensis.
Hylocichla aonalaschkæ.
Merula migratoria.
Hesperocichla nævia.

SPECIES OCCURRING ON WHITE PASS SUMMIT AND IN THE YUKON VALLEY.

Sayornis saya yukonensis.
Zonotrichia coronata.
? Wilsonia pusilla pileolata.
Anthus pensilvanicus.
Hirundo erythrogastra unalaschkensis.

SPECIES FOUND BY US ONLY ON WHITE PASS SUMMIT.

Lagopus rupestris.
Lagopus leucurus.
Zonotrichia coronata.
Leucosticte tephrocotis littoralis.

SPECIES FOUND BY US ONLY ON THE COAST OF SOUTHEAST ALASKA.

? Dendragapus obscurus fuliginosus.
Sphyrapicus ruber.
Cyanocitta stelleri.
Corvus caurinus.
Junco hyemalis oregonus.
Junco hyemalis connectens.
Melospiza melodia rufina.
Melospiza lincolni striata.
Passerella iliaca townsendi.
Helminthophila celata lutescens.
Anorthura hiemalis pacifica.
Parus rufescens.
Regulus satrapa olivaceus.
Regulus calendula grinnelli.

LAND BIRDS FOUND IN LYNN CANAL DISTRICT ONLY NEAR TIDE WATER.

Contopus richardsoni saturatus.
Sphyrapicus ruber.
Cyanocitta stelleri.
Corvus caurinus.
Spizella monticola ochracea.
Junco hyemalis oregonus.
Melospiza melodia rufina.
Melospiza lincolni striata.
Tachycineta bicolor.
Helminthophila celata lutescens.
Anthus pensilvanicus.
Sitta canadensis.
Merula migratoria.

LAND BIRDS FOUND IN LYNN CANAL DISTRICT ONLY NEAR THE LEVEL OF GLACIER.

Colaptes auratus luteus.
?Dendragapus obscurus fuliginosus.
Junco hyemalis connectens.
Wilsonia pusilla pileolata.
Cinclus mexicanus.
Anorthura hiemalis pacifica.
Regulus satrapa olivaceus.

SPECIES RECORDED FROM THE UPPER YUKON ONLY ABOVE THE PELLY RIVER.

Tringa minutilla.
Symphemia semipalmata inornata.
? Megascops asio kennicotti.
? Dryobates villosus hyloscopus.
Chordeiles virginianus.
Selasphorus rufus.
Contopus borealis.
Hirundo erythrogastra unalaschkensis.
Tachycineta bicolor.
Helminthophila peregrina.
Dendroica townsendi.
Wilsonia pusilla pileolata.
Hylocichla aonalaschkæ.
Hylocichla aonalaschkæ pallasi.
Sialia arctica.

SPECIES RECORDED FROM THE YUKON VALLEY BETWEEN FORT YUKON AND THE PELLY RIVER.

Falco peregrinus anatum.
? Falco columbarius.
? Falco columbarius richardsoni.
Empidonax trailli alnorum.
Otocoris alpestris leucolæma.
Calcarius lapponicus alascensis.
Acanthis hornemanni exilipes.
Passerella iliaca.
Seiurus noveboracensis notabilis.
Wilsonia pusilla.
Hylocichla aliciæ.
Saxicola œnanthe.

ANNOTATED LIST OF SPECIES.

1. **Æchmophorus occidentalis.** Western Grebe.

Several seen at Bocadequadra, near Dixon Entrance, May 28.

2. **Colymbus holbœlli.** Holbœll Grebe.

A young male was taken on the 'Canal' at St. Michael September 22. The irides were primrose yellow; basal two-thirds of the culmen, outside tarsi, and lobes, seal brown; rest of bill, ocher yellow; inside of the tarsi and lobes, maize yellow; nails, yellowish olive buff.

3. **Gavia imber.** Loon.

Seen at Bocadequadra May 28 and in the Inside Passage May 29. Several seen on Lake Bennett and a pair at Caribou Crossing between June 17 and 28. On Lake Marsh they were common and were frequently heard, especially at night. The last loon certainly referable to this species was seen there July 6.

4. **Gavia arctica.** Black-throated Loon.

A loon that flew over our boat on Thirty-Mile River July 18, and another seen near Big Salmon River July 20, I believe were *Gavia arctica.* I saw several loons at the Aphoon mouth of the Yukon August 27 and one at St. Michael on September 5 and 16. We obtained none of them, but the experience of others makes it probable that all were the black-throated. Dr. Romig, of the Moravian Mission on the Kuskokwim River, told me that his party killed two on August 27 on the portage from Bethel on the Kuskokwim to Hendricks Station on the Yukon Delta.

5. **Lunda cirrhata.** Tufted Puffin.

Osgood saw one at Whale Island, near St. Michael, September 8.

6. **Fratercula corniculata.** Horned Puffin.

We took two and saw about a dozen puffins near Whale Island September 8. Irides, drab gray; ring on eyelid and tip of bill, flame scarlet; rest of bill dull straw yellow; bare skin at gape and line along base of maxilla, cadmium yellow; line below lower eyelid and horns, black; palmations, cadmium orange; tarsi and toes, cadmium orange above, chrome yellow below; nails varying from drab gray to slate color.

7. **Simorhynchus pusillus.** Least Auklet.

Auklets were seen several times while we were crossing Bering Sea in the *Corwin* October 1–2 and increased in numbers as we approached the Pribilofs. They were common with various other (unidentified) species of water birds off Unalaska October 4 and abundant in Akutan Pass October 6. I refer them to this species, as Nelson found it the most abundant in these waters.

8. **Brachyramphus marmoratus.** Marbled Murrelet.

This bird was fairly common in the Inside Passage May 28–29, and one was killed at Bocadequadra. We saw a few on Lynn Canal May 30, and I shot one near Skagway May 31. Doubtless some of the many murrelets seen with auklets near the Pribilof and Aleutian islands in October were this species.

9. **Cepphus columba.** Pigeon Guillemot.

Seen at Bocadequadra and along the Inside Passage May 28–29. Guillemots which I saw near Unalaska October 4 were probably this species.

10. **Uria lomvia arra.** Pallas Murre.

The murres seen near St. Michael August 29 and about St. George Island and Unalaska in October were probably chiefly this species, though some may have been *Uria troile californica*.

11. **Stercorarius parasiticus.** Parasitic Jaeger.

Common at the Aphoon mouth of the Yukon August 27–28, and about St. Michael until September 10. About this time their numbers decreased, and the last one was seen September 16. All appeared to be adults (as were the four collected), and only one was in the black plumage.

12. **Stercorarius longicaudus.** Long-tailed Jaeger.

I saw one at the Aphoon mouth August 28, and both Osgood and I occasionally saw the species at St. Michael until September 12.

13. **Rissa tridactyla pollicaris.** Pacific Kittiwake.

Adult kittiwakes were tolerably common at St. Michael from September 19 to the end of our stay, but no young were seen. As we crossed Bering Sea October 1–5, and at Unalaska October 5–6, young kittiwakes were common, and we saw no adults except at St. George and Unalaska. The irides of the adult are vandyke brown; ring on eyelid orange rufous; bill sulphur yellow, whitish at tip; gape rufous; tarsi, toes, palmations, and nails slate black.

14. **Rissa brevirostris.** Red-legged Kittiwake.

One was seen by Osgood at Unalaska (Dutch Harbor) October 5.

15. **Larus barrovianus.** Point Barrow Gull.

Abundant on the Lower Yukon, at the Aphoon mouth, and during September at St. Michael, though most of the adults had gone by the middle of the month. While crossing Bering Sea we saw several young October 2 and others near Unalaska October 4. A young bird shot near St. Michael September 19 had the head of a recently killed ptarmigan in its throat. The irides of the young are Prout's brown; tip of bill and sides of nails black; rest of bill, toes, and palmations vinaceous buff; rest of nails drab gray.

16. **Larus glaucescens.** Glaucous-winged Gull.

Large gulls, which doubtless were chiefly this species, were common from Dixon Entrance to Lynn Canal May 28–30, and we saw a few near Skagway June 1–2. At Unalaska, where I collected two, they were abundant October 4–6. A few gulls that followed the *Corwin* in the North Pacific I think also belonged to this species.

17. **Larus argentatus smithsonianus.** American Herring Gull.

The only large gulls I took on the Yukon—a female which had finished laying, collected at Lake Tagish June 30, and another taken near Charlie Creek August 8—were this species, and no others came close enough to make identification positive; hence I must refer all the large gulls seen to *Larus a. smithsonianus*, although on several we could see no black on the primaries. I saw one flying over White Pass Summit June 12 and another at Bennett City June 19. We saw eight or ten at Caribou Crossing and a few on Lake Tagish. No more were observed until we reached Lake Lebarge July 13; but from this point to the mouth of the river large gulls slowly became more numerous, one or two being noted every few days. Three fully grown young, with their parents, were seen on a sand bar about 15 miles above Circle August 12.

18. **Larus brachyrhynchus.** Short-billed Gull.

Our acquaintance with this bird dates from our arrival at Lake Marsh, July 1, where we found it common, and took downy young the next day. From this time, until we reached the Tatchun River, July 23, hardly a day passed that we did not see several; on July 20 we counted fourteen on a sand bar near Little Salmon River. After July 23 we saw no more until September 6, when young of the year appeared at St. Michael, and were common there until the 23d. The only adult seen at St. Michael was noted on September 14.

The adult has the irides Prout's brown; ring on eyelids and skin at commissural angle reddish orange; gape orange; bill, tarsi, and toes olive yellow; nails black, french gray at base.

Natal plumage: Creamy white, becoming pale cream color on forehead, chin, and anterior breast, mottled with different shades of brown, except the center of chest and abdomen. Head markings slate-black, distinctly defined and numerous, the most characteristic being one that covers the entire nasal region, a V on the pileum, a W on the occiput, and a somewhat interrupted U on each side of the throat. On the upperparts the markings become pale seal brown, and with lighter tips render the lower neck, sides of breast, flanks, and anal region grayish. Bill brownish black; tip of bill, tarsi, toes, and palmations whitish; nails and edges of scutellæ of tarsi and toes hair brown.

19. **Larus philadelphia.** Bonaparte Gull

I saw several small black-headed gulls, probably this species, in the Inside Passage May 29. I took a Bonaparte gull at Caribou Crossing on June 24 and saw several others. We saw one on Lake Marsh July 1, a few young at St. George Island October 3, and found them common at Unalaska October 4–5.

20. **Xema sabinii.** Sabine Gull.

Osgood found a dead bird of this species on the shores of Chilkat Inlet June 1. The specimen, unfortunately, was not in a condition to permit its preservation, but it was carefully identified at the time and showed no apparent variance from the description and figure in Ridgway's Manual.

21. **Sterna paradisæa.** Arctic Tern.

We saw a large flock of terns in the Inside Passage May 29, and two days later at Skagway saw a few more, securing two, which proved to be of this species. At Bennett, between June 15 and 20, we frequently saw two or three, and I was informed that arctic terns bred on a small lake near Log Cabin, British Columbia. We found a breeding colony of about twenty on a small rocky island lying in the entrance to Windy Arm, Lake Tagish, July 1. I found four single eggs (three fresh and one well advanced in incubation), one set of two (one fresh and the other at point of hatching), and also a young bird which had just left the shell. There were no nests; the young bird and eggs were in the short grass on the top of the island. Except a single bird, seen at Lake Marsh and probably belonging to this colony, we did not meet with terns again until August 27, when I found this species common at the Aphoon mouth. A single tern with injured primaries was seen frequently at St. Michael up to September 21. The downy young differs from the description given in Baird, Brewer and Ridgway's 'Water Birds,' in having the forehead plain dusky, the chin whitish, the basal half of bill, tarsi, and toes salmon pink, and the rest of bill and nails black.

22. **Diomedea albatrus.** Short-tailed Albatross.

A dark-brown albatross, probably the young of *D. albatrus*, joined the *Corwin* October 1, about 150 miles from St. Michael. It was soon accompanied by others, and until we reached Cape Scott, October 12, a glance astern would seldom fail to show two or three following the vessel.

23. **Fulmarus glacialis glupischa.** Pacific Fulmar.

A single dark-colored fulmar, possibly this form, was seen October 4, between St. George and Unalaska.

24. **Oceanodroma furcata.** Forked-tailed Petrel.

To this species I refer a few light-colored petrels seen October 3, on Bering Sea north of the Pribilof Islands.

25. **Phalacrocorax pelagicus.** Pelagic Cormorant.

Cormorants were seen October 4 near Unalaska, where this species is reported as common.

26. **Phalacrocorax pelagicus robustus.** Violet-green Cormorant.

We saw a single cormorant at Whale Island September 8; and one—possibly the same bird—was seen by Osgood several times at St. Michael.

27. **Phalacrocorax urile.** Red-faced Cormorant.

This is the only cormorant reported by William Palmer from St. George, where we saw several October 3.

28. **Merganser americanus.** American Merganser.

A pair of mergansers was breeding on a small, rocky island in Lake Tagish, at the entrance to Windy Arm, June 30–July 1. The nest was found by Osgood in a crevice in the cliffs about 15 feet above the water. It was made of down, and contained seven eggs about one week advanced in incubation. Retrieving would have been impossible had we shot the bird, but as I succeeded in watching the female on the nest from a distance of less than 6 feet I feel positive of the species.

A few other mergansers, usually in pairs, were seen on Lake Tagish July 1, on Lake Marsh July 8, at Fifty-Mile River July 9 and 12 (a flock of a dozen males flying up the river in the evening of the latter date), near Little Salmon River July 20, and about 25 miles above Circle August 12. Near Charlie Creek we found the dried wing of an adult male of this species August 8.

29. **Anas boschas.** Mallard.

On the flats of Chilkat Inlet I saw seven June 2. In no part of the Yukon Valley above Circle did we find ducks abundant, except surf scoters, but the mallard undoubtedly occurs at all suitable places throughout the region. It must breed very early, as on June 24, only three weeks after the lakes were open to steamer navigation, I found a female with two young at Caribou Crossing, and on June 28 I shot another female there and caught two of her half dozen downy young. Two ducks, probably mallards, were seen on Lake Marsh July 6, and at Miles Canyon Maddren was informed they had been common there earlier in the season. We saw several females with young in the marshy ponds at the foot of Lake Lebarge July 17, a few adults near the Little Salmon July 20, and a good-sized flock near Charlie Village August 10. Osgood shot one near Fort Yukon August 21.

In the large flocks of geese and ducks disturbed by the steamer on the Lower Yukon were two young mallards, secured at Hendricks Station August 25. Mallards were common at the Aphoon mouth August 27, and we saw a few at St. Michael September 2.

30. **Mareca americana.** Baldpate.

Five ducks that I took to be baldpates were seen a short distance above Fort Selkirk July 25.

31. **Nettion carolinensis.** Green-winged Teal.

Three teal that I saw in the creek at Circle, August 19, were probably this species. Green-winged teal were common in the tundra ponds about St. Michael during the first half of September, but apparently did not occur after September 16. All that were taken were young birds.

32. **Dafila acuta.** Pintail.

Maddren was told at Miles Canyon, July 11, that pintails were common, but we saw none near enough for identification until August 27, when I found them abundant at the Aphoon mouth. Seven were here killed by a passenger on the steamer. During September young pintails far outnumbered all other ducks on the marshes and tundra ponds about St. Michael. Large numbers were killed by the Eskimos, but no adults were seen. Their numbers had greatly decreased by September 20.

33. **Aythya marila.** Scaup Duck.

We saw a flock of about a dozen adult males at Caribou Crossing June 24, and another of about twenty on the Yukon, a short distance above Fort Selkirk, July 25.

34. **Aythya affinis.** Lesser Scaup Duck.

We found a pair with young on a small pond at Lower Lebarge July 17. Osgood secured the female.

35. **Clangula clangula americana.** American Golden-eye.

I am confident that a flock of ducks seen about 25 miles above Circle August 12 were males of this species or of *C. islandica.*

36. **Charitonetta albeola.** Buffle-head.

I shot a female on a small pond near Lake Marsh July 8, and saw a male near Little Salmon River July 20. Maddren was informed that buffle-heads were common near Miles Canyon, and a boy at Lower Lebarge said they bred commonly on the ponds near there, and that he took two young July 16.

37. **Harelda hyemalis.** Old Squaw.

Single young birds were found frequently during September in the small ponds about St. Michael, and a flock of about a dozen was seen in the harbor September 11. No adults were observed. One young bird, taken early in September, still retained natal down on the hind-neck.

38. **Histrionicus histrionicus.** Harlequin Duck.

We saw a male and two females in Wrangell Narrows May 29. A flock of twelve males came close to the shore at Bennett June 18; and on June 23 a single male swam so near that men sitting on the beach threw stones at it. One other harlequin was seen a few miles above Fort Selkirk July 25. Dr. Romig told me he saw a number on the portage from the Kuskokwim to the Yukon August 24-25.

39. **Somateria v-nigra.** Pacific Eider.

We saw the head of a male of this species lying in the window of the hotel at St. Michael, and the soldiers at the barracks had a mounted bird, shot near St. Michael in the spring, but we saw no living eiders of any species during our trip.

40. **Oidemia americana.** American Scoter.

We noticed a few in Wrangell Narrows May 29, and I saw a number off Unalaska October 5.

41. **Oidemia deglandi.** White-winged Scoter.

This species was fairly numerous at Bocadequadra, Wrangell Narrows, and Lynn Canal May 28–30. We saw two on Lake Marsh July 6, two on Lake Lebarge July 14, and a flock of about twenty-five flying up Fifty-Mile River from Lake Lebarge on the evening of July 12.

42. **Oidemia perspicillata.** Surf Scoter.

In Lynn Canal, near Haines, June 1 we noted a large flock of surf scoters, most of which had disappeared the next day. They were abundant on all the Yukon lakes except Bennett, which was almost destitute of bird life. On Lake Tagish we saw fourteen June 30, and at Lake Marsh thirty to forty males almost every day between July 1 and 8. We saw no more, except a pair on July 11 on Fifty-Mile River, which connects Lake Marsh with Lake Lebarge, until we entered Lake Lebarge on the evening of July 12, when a flock of at least a hundred flew high overhead from the direction of the lake. About 8 p. m. and at 10 p. m. of the same evening, and on the next morning, we saw what we took to be the same flock. The birds were probably taking a morning and evening flight, such as E. S. Bryant has noticed in the case of the white-winged scoters breeding at Devils Lake, North Dakota; and I believe that with both species these flights are taken chiefly to exercise the wing muscles. We saw no females on any of the lakes, nor could we find them on the shore, though they were undoubtedly nesting in the vicinity. We observed several on Thirty-Mile River July 18 and two near the Little Salmon July 20. Near Whale Island, at St. Michael, we saw a number September 8, and two scoters, probably young of this species, September 21. I think there were a few with the American scoters I saw at Unalaska October 5.

43. **Chen hyperborea.** Lesser Snow Goose.

I saw five snow geese at the Aphoon mouth August 28, and a large flock at St. Michael September 11.

44. **Anser albifrons gambeli.** American White-fronted Goose.

A single white-fronted goose was seen by Osgood among a number of other birds killed by natives about the Yukon Delta August 29.

45. **Branta canadensis hutchinsi.** Hutchins Goose.

Although Maddren was informed that a goose with four young was seen near White Horse Rapids about July 11, and although the sergeant in charge of the police station of Lower Lebarge told us that thousands of geese and ducks passed there in the spring, and that he had counted twenty-four distinct species, and had killed both Hutchins and cackling geese, we did not see a goose of any species until we were in the neighborhood of Charlie Village, August 10. There we saw a flock of about twenty of the *Branta canadensis* group, and Osgood shot two *hutchinsi* and saw many more near Fort Yukon August 21. Brown geese, apparently chiefly this subspecies, were common on the Yukon flats and on the lower river, especially the Yukon Delta. A Hutchins goose was brought to the steamer *Robert Kerr* by an Eskimo August 26, and I found the bird common at the Aphoon mouth August 27–28. Prospectors on the *Kerr* told me that geese bred abundantly at the head waters of the Porcupine and the marshes at the source of Birch Creek.

During September this species was common about St. Michael in small flocks, but very shy; Osgood took one September 23.

[*Philacte canagica.* Emperor Goose. Dr. Romig told me they were common on the tundra along the Kuskokwim.]

[*Olor columbianus*. Whistling Swan. We were told that a swan—probably this species—was killed at Circle during the spring.]

46. **Grus canadensis.** Little Brown Crane.

Along the Yukon we did not see any cranes, although I thought I heard one near the Little Salmon July 21, and a man who had spent the summer at Circle told me he had heard and seen the 'sand-hill crane' there frequently during the past two months. I was also informed by prospectors that these cranes were found in small numbers at the head waters of Birch Creek and Porcupine River.

Near St. Michael we saw flocks of from two to six individuals each almost daily during the first half of September, but none later than September 15. On the night of September 13 and all the following day there was a hard southwest gale. On the 14th we saw large numbers—Osgood counted ninety-six—flying south, high in the air.

47. **Crymophilus fulicarius.** Red Phalarope.

We saw a small flock near Skagway in Lynn Canal June 2, and others I believed to be this species near Wrangell Narrows and in Prince Frederick Sound May 29. Osgood took one at St. Michael September 17 during a heavy storm.

48. **Phalaropus lobatus.** Northern Phalarope.

Large flocks were seen near Dixon Entrance May 28, and smaller ones on the Inside Passage May 29. From a flock of about twenty on Lake Lebarge July 13 I shot a female that was changing to winter plumage, and on a small pond at Lower Lebarge July 17 I took a male that was in worn breeding plumage. At St. Michael September 2 I caught a young bird that had but one wing, and on St. George Island October 3 I shot one that was swimming alone in a pool. Phalaropes, probably this species, were seen on Bering Sea October 1 and 4.

49. **Gallinago delicata.** Wilson Snipe.

At Haines May 31 I was told that several Wilson snipe had been seen that day, but was unable to find them. We saw one on Fifty-Mile River not far below Lake Marsh July 10, and another in the marsh at Lower Lebarge July 17. Osgood saw one at Circle August 18, and I killed two from a small flock at Hendricks Station August 25. At St. Michael we saw eight or ten single birds between September 12 and 22.

50. **Tringa couesi.** Aleutian Sandpiper.

Common about the lava rocks that line the shore at St. Michael, where flocks of five to fifty were observed, but only small flocks after September 15. A few were occasionally seen on the tidal mud flats, but none about the ponds in the interior of the island or on the salt meadow behind the town. Out of eighty specimens taken only eight were adults, and five of these were taken before September 9. On the rocky shores of a point opposite Dutch Harbor, Unalaska, I found them common October 5. Those taken at St. Michael were molting into first winter plumage, which is practically complete in the Unalaska birds. In this plumage there is considerable individual difference in the width and shade of the pale edgings of the feathers of the upperparts.

The irides were vandyke brown; bill, black changing to olive buff in basal half; tarsi and toes, yellowish olive buff washed with black; nails black.

I find great sexual variations in size in this species, the females, as in many other species of Limicolæ, averaging considerably larger, especially in length of bill. Measurements of twenty-nine males: Length 8.06 to 8.94 (average 8.57) inches; wing 4.37 to 5.12 (average 4.89) inches; exposed culmen 0.96 to 1.13 (average 1.06) inches; tarsus 0.91 to 1.03 (average 0.96) inches. Measurements of thirty-four females: Length 8.56 to 9.56 (average 9.03) inches; wing 4.47 to 5.31 (average 4.98) inches; exposed culmen 1.16 to 1.42 (average 1.24) inches; tarsus 0.96 to 1.05 (average 0.99) inches.

51. **Tringa ptilocnemis.** Pribilof Sandpiper.

We saw a number on St. George October 3, but too close to the rookery of fur seals to be obtained.

52. **Tringa acuminata.** Sharp-tailed Sandpiper.

First found September 18, when six were seen with a large flock of *T. a. pacifica* at St Michael. We did not see more than a dozen of this species during the rest of September. Although the species has not been hitherto recorded from St. George Island, we took three and saw about a dozen during the short time we were there October 3. At Unalaska, October 5, I secured one which was with *T. couesi* on the rocky beach. The irides were vandyke brown; maxilla and distal half of mandible, dark seal brown, mandible changing to dull olive buff at base; gape ecru drab; tarsi and toes, greenish maize yellow; nails black.

53. **Tringa maculata.** Pectoral Sandpiper.

This species was present throughout our stay at St. Michael, usually associating with flocks of *T. a. pacifica*, but in very small numbers, not more than twenty being seen. All the specimens taken were young birds. Osgood took one at St. George October 3, and I one at Unalaska October 5.

54. **Tringa bairdi.** Baird Sandpiper.

Two sandpipers, probably of this species, flew by us on Lake Marsh, and we saw four more in the marshes of Lower Lebarge, but failed to secure any of them. I shot one young bird near the Tahkandik River August 7. Osgood shot one from a flock of four at Circle August 15, and another near Fort Yukon August 21.

55. **Tringa minutilla.** Least Sandpiper.

At the southern end of Lake Marsh, not far from where Six-Mile River enters, the surrounding country is level, and at high water the lake stretches far back through a dense growth of willows. At the time of our visit the retreating water of the lake had left a belt of grass between these willows and its margin. Here on the evening of July 2 I found three pairs of least sandpipers, and after a long search, somewhat interrupted by hordes of mosquitoes, I came upon a female surrounded by four downy young. Both parents tried time and again the well-known 'wounded-bird' tactics to lure me from the spot where the young were hidden in the bunches of grass, and, finding this a failure, would circle around me only a few yards off, uttering a plaintive twitter. I saw two other least sandpipers on the west shore of Lake Marsh July 7.

Natal plumage: Lower parts, forehead and orbital region, brownish white. Upperparts bright cinnamon rufous mottled with black; many feathers, especially on head, rump, and tail, tipped with white. Postorbital line and loral line blackish, and spot of bright cinnamon rufous on sides of chest. Irides dark brown; bill and nails, slate black; tarsi and toes, pale slate.

56. **Tringa alpina pacifica.** Red-backed Sandpiper.

Young red-backed sandpipers were very abundant at St. Michael during our stay, many times outnumbering all other Limicolæ. Early in September they frequented chiefly the mud flats on the coast, but after the middle of the month large numbers were found only about the pools of the salt marsh. September 24, when the tundra was quite thoroughly frozen, with snow in every hollow and a skimming of ice on the pools, I saw at least one hundred in this latter place.

In several taken early in September the back of the neck was still covered with down, but the majority were in full juvenile plumage. Some still retained this plumage at the time we left St. Michael, but the larger portion had molted into winter plumage. Only two adults were taken, September 1 and 5. A few were seen at St. George Island October 3.

57. **Calidris arenaria.** Sanderling.

I saw three at St. Michael September 11 and collected one, which proved to be a young female.

58. **Totanus flavipes.** Yellow-legs.

On July 1, while floating down Six-Mile River close to its entrance into Lake Marsh, we were attracted by the anxious cries of a pair of yellow-legs. Osgood shot both birds, and we found two downy young in the grass on the shore of the river. Entering Lake Marsh we heard a yellow-legs' whistle, and on July 2 I saw a yellow-legs near where I found the least sandpiper. I collected a female on the west shore of Lake Marsh July 8, and a male, the last bird of this species seen, near a small pond at Lower Lebarge July 17. Both these birds undoubtedly had eggs or young close by, for they alighted exclusively in trees, scolded vociferously, tilting the body with each cry, and refused to leave. Bare spaces on the breast show that both sexes assist in incubation.

Natal plumage: Upperparts and thighs, dark seal brown, many of the feathers tipped with cream buff and whitish; longitudinal lines on rump, cream color, inclosing central, seal-brown space. Forehead, buffy white, extending in narrow lines on sides of crown to occiput, and in broader lines above eye to nape, the latter crossed by transverse dark lines extending from eye to occiput. Line beginning at base of culmen enlarged to dark space on crown and occiput, extending down neck to back, seal brown; other dark lines extending from crown above eye to occiput, and from nostrils through eye to nape. Throat and center of abdomen silvery white; rest of lower parts and sides of neck, buffy white; each feather of lower parts becoming brownish black at base. Irides, vandyke brown; bill, black at tip, changing to greenish olive at base; tarsi and toes, yellow, paler than in adult, and mottled with brown; nails, brown. The juvenile plumage is appearing, in this specimen, on wings, wing coverts, chest, and sides.

59. **Helodromas solitarius cinnamomeus.** Western Solitary Sandpiper.

At Log Cabin, British Columbia, on the evening of June 14, we noticed a sandpiper wheeling through the air, like the woodcock at its breeding place, occasionally uttering a rather musical whistle. The next morning I found it feeding in a small swamp. It proved to be a solitary sandpiper, as I had suspected on the previous evening. Osgood saw another near Lake Marsh July 5, and I saw two near Little Salmon River July 21. On July 8, after rowing a few miles down Lake Marsh, we stopped for lunch on the west shore, where a forest fire had killed most of the trees, and fallen trunks piled in endless confusion, brush, small pools, and hordes of mosquitoes rendered the place anything but a paradise. Here I startled a solitary sandpiper and a yellow-legs at the same instant. They lighted on the half-fallen trees and scolded me, tilting their bodies at each cry. The solitary sandpiper, which doubtless had a nest there, differed chiefly from eastern specimens of *solitarius* in having dark, wavy markings on inner webs of outer primaries. Osgood took a typical young of *cinnamomeus* and saw another on an island near Sixty-Mile Creek August 1.

60. **Symphemia semipalmata inornata.** Western Willet.

While in a meadow a short distance back from the southeast end of Lake Marsh July 2 I heard a willet whistle several times its unmistakable 'pill-willet,' but failed to see the bird.

61. **Heteractitis incanus.** Wandering Tattler.

Osgood took an adult at Skagway May 31. I shot a young bird from a flock of three at St. Michael September 1, saw one on Whale Island September 8, and secured two at Unalaska October 5.

The irides of the adult were vandyke brown; bill, black, base of mandible brownish; tarsi and toes, brownish ocher; nails, black. In the young, the bill changed from black to sage green in basal third of mandible, and to greenish olive at base of maxilla; tarsi and toes, dull gallstone yellow, greenish at joints.

62. **Actitis macularia.** Spotted Sandpiper.

I saw one at Skagway June 3, and Osgood one at Glacier June 8. This is preeminently the shore bird of the Yukon Basin; we saw two at Bennett June 18, and until we reached Circle, August 15, hardly a day passed without our seeing many running along the shore, or skimming over the river. They were especially abundant between White Horse Rapids and Lake Lebarge. After the 1st of August most of the spotted sandpipers seen seemed to be traveling upstream in small flocks. We saw no adults after August 4.

The first set of eggs was found at Caribou Crossing June 27; the last at the Tatchun River July 23. The first young noticed were in a nest containing three young and one pipped egg found on Lake Marsh July 7. Both sexes were incubating. Nests were close to the shore, and also on small rocky islands in the lakes.

63. **Numenius hudsonicus.** Hudsonian Curlew.

I secured one from a flock of four curlews on the marshes of Chilkat Inlet, and Osgood found a dead bird in the woods at Haines, June 1. Three young were brought to the steamer by an Eskimo at the Aphoon mouth August 28. I saw one at St. Michael September 2, and, I think, another September 14.

Adult: Irides, vandyke brown; bill and nails, black; tarsi and toes cinereous. Young (Massachusetts specimen): Irides, raw umber; maxilla, black; mandible, clove brown, blackish at tip, vinaceous toward base; tarsi and toes, olive gray; nails, black.

64. **Squatarola squatarola.** Black-bellied Plover.

At the Aphoon mouth of the Yukon I saw a flock August 28. Osgood saw three young which had been shot on the mainland near St. Michael September 10, and from this date to the end of our stay we saw occasionally one or two birds of the year, one of which was taken September 16.

65. **Charadrius dominicus fulvus.** Pacific Golden Plover.

None were seen until September 16, after which young birds became fairly common on the boggy tundra about St. Michael and the mud flats along the shore. The only adult seen was taken by Osgood September 25. We saw a number of young birds on St. George Island October 3, and Osgood secured one. Crossing Bering Sea we saw some near Unalaska October 4, and I saw one on October 8, when we were several hundred miles south of the Aleutian Islands. This bird flew several times around the *Corwin*, answering my every whistle, and seemed anxious to alight. The specimens collected differ greatly in the amount of the golden coloring, but all are far more golden than Massachusetts skins of *dominicus*, and all have the shorter wings of *fulvus*. Irides, vandyke brown; bill and nails, black; tarsi and toes, slate gray.

66. **Ægialitis semipalmata.** Semipalmated Plover.

Osgood collected a male at Caribou Crossing June 24, and a pair of adults and one pipped egg at the southern end of Lake Marsh July 2. I removed the young bird from the shell, and within half an hour the down was almost dry, the eyes were open, and it could hop about on its 'knees.' Maddren took another adult at this place July 6, and I a female and four eggs nearly hatched, on the west shore of Lake Marsh on the same day. The nest was a hollow, lined with a few grasses and dead leaves, and was situated about 8 feet from the water in the drift débris among the stones of the beach. We saw three or four on a sand flat near Charlie Village August 10; a few about 15 miles above Circle August 12, and the last at Circle August 15.

Bare pectoral spaces showed that both sexes assist in incubation. Natal plumage: Lower parts, white, separated by broad bare space on neck, changing to cream color on lower tail coverts. Above, cream color, mottled with black, changing to buff on wings and tail. Forehead and infraorbital patches, cream color; broad band on neck encircling head, white, bordered above by narrow band of black extending from bill around occiput, and connecting in malar region with black line leading to inner canthus of eye. Spot on forehead, on sides of chest at lower border of bare space, on sides and on flanks, black. Irides, dark; bill and nails, black; tarsi and toes, slate color, whitish posteriorly.

67. **Arenaria melanocephala.** Black Turnstone.

We found a small flock on the rocky shore at St. Michael August 31; I took three young there the next day, and on September 5 I saw a single turnstone flying across the marsh. On St. George Island, October 5, we saw a number of birds that we had no doubt were black turnstones, but I do not find this species recorded from the Pribilofs, and we were unable to obtain specimens. Irides, vandyke brown; bill, olive black; tarsi and toes varying from clay color to vinaceous cinnamon, and washed with black; nails, black.

68. **Dendragapus obscurus fuliginosus.** Sooty Grouse.

We were told that grouse were common on the heights above Skagway, but although we often found droppings we saw no birds, and the spring 'calling' of the male had ceased. Maddren and I heard a bird that must have been this species 'booming' far up on the hillside from the ravine above Glacier June 8.

69. **Canachites canadensis osgoodi.** Alaska Grouse.

Canachites canadensis osgoodi Bishop, Auk, XVII, 114, April, 1900.

We first met the Alaska grouse at Bennett City, where Osgood shot a laying female June 22. At Caribou Crossing he found feathers of this grouse in a magpie's nest and in one of his mammal traps. At Lake Marsh he shot four females and four young July 4–5, at Lake Lebarge a female July 14, at Lower Lebarge a female and one young July 17, and on Thirty-Mile River an adult male July 19. He found the birds frequenting the thickets of poplars and young spruces and remarkably easy to approach. I saw a male at Lake Lebarge July 16, and shot a well-grown young near the Tatchun River July 16, but did not meet with the species elsewhere. This bird was reported as common at Lower Lebarge by the police sergeant stationed there; at Rampart City by Mr. Burkman, and along the Kuskokwim by Dr. Romig.

70. **Bonasa umbellus umbelloides.** Gray Ruffed Grouse.

I secured a female and one young bird on the west shore of Lake Lebarge July 14, and another female that had a brood of young, two-thirds grown, at Lower Lebarge July 17. Osgood took a young bird from a covey near Rink Rapids July 22. The sergeant at Lower Lebarge called this species rare, but I was told it was common near Rampart City.

71. **Lagopus lagopus.** Willow Ptarmigan.

Two flocks were found on the tundra at the Aphoon mouth August 28, one alighting close to the steamer. Not seen at St. Michael until September 11, when about one hundred appeared. These were seen frequently after this date, but were exceedingly shy. Most of those taken were young birds, and all were in full molt. The irides of a young male taken September 19 were vandyke brown; skin above eye, rufous; bill, slate black, whitish at tip and salmon buff at base of mandible; nails, white.

We were told that ptarmigan were very abundant near Atlin, British Columbia, at the head waters of the Porcupine River and Birch Creek, near Rampart City, along the Kuskokwim, and in winter at Glacier and Lower Lebarge. Doubtless some of these statements refer to the following species.

72. **Lagopus rupestris.** Rock Ptarmigan.

At White Pass Summit, June 11 and 13, we took three males still in white plumage (excepting a few dark feathers on head and lower neck), and saw a few others. Osgood found two eggs there, probably of the previous year, lying on the moss under an alpine hemlock. Dr. Romig told me that this species was more common than *L. lagopus* along the Kuskokwim.

[*Lagopus rupestris nelsoni.* Nelson Ptarmigan. We were told at Unalaska that this species had been abundant during the summer on Unalaska Island, but that the birds had been almost exterminated by the officers of an English man-of-war. We saw none during the day and a half we were there.]

73. **Lagopus leucurus.** White-tailed Ptarmigan.

Osgood took a white-tailed ptarmigan June 8 on the summit of the cliffs above Glacier, and saw several other ptarmigan, probably of this species. On June 8 he found at the same place, on the moss under an alpine hemlock, fragments of two ptarmigan eggs, sparingly dotted with brown as in *leucurus*.

74. **Circus hudsonius.** Marsh Hawk.

We saw one at Lake Marsh July 8, one at Lake Lebarge July 12, a young bird on which duck hawks were feeding near the Tahkandik River August 7, one about 20 miles above Circle August 12, and two at Circle August 15 and 20. At the Aphoon mouth I saw several August 28. At St. Michael we secured a young bird September 2, and saw single marsh hawks on September 6, 7, and 11. The young bird taken is noticeably darker than young from Dakota and New England.

75. **Accipiter velox.** Sharp-shinned Hawk.

I saw one at Lower Lebarge July 17, and two near White River July 30; Osgood found one feeding on a thrush near Charlie Creek August 9; at Circle I saw one August 17 and shot an adult female August 19. Osgood found a nest of this species, about 15 feet from the ground, in a small spruce in the center of an island near the Nordenskiold River July 22, and I secured the female, whose crop held the tibia, tarsus, and toes of a flicker. The nest contained three downy, but very pugnacious young, one infertile egg, and the remains of a young intermediate sparrow. I kept two of the young alive until July 31, when both were well feathered and trying to fly and were as irascible as ever. The last survivor succeeded in getting out of his box while we were moored at Dawson, flew into the Yukon, and was carried rapidly along by the current, though struggling valiantly to reach the shore. I suspect that it succeeded, as I heard a man who hurried after it say later that he would have 'fricasseed chicken for dinner.'

76. **Accipiter atricapillus.** American Goshawk.

I saw an adult flying high above the shore of Lake Marsh July 8 with a mammal, probably a ground squirrel, in its talons.

77. **Buteo borealis calurus.** Western Red-tail.

This is presumably the common hawk of the Upper Yukon; for the two large hawks taken are this species, and the numerous others seen resembled these in appearance, flight, and cry. About half were in the melanistic plumage.

Passing down Six-Mile River July 1 we saw three large buteos circling, and we noticed others frequently, usually in pairs, until we left Circle. Osgood and Maddren found a nest near Lake Marsh July 5 regarding which a pair of these birds were very solicitous. It was high in a spruce, and was empty except for a dead ground squirrel. On Fifty-Mile River July 10 I found a nest that was about 55 feet up in a spruce and contained two downy young. Osgood shot the female, which was in light plumage; the male, a melanistic bird, escaped. Osgood shot a melanistic female at Lower Lebarge July 17, and I found a pair—one light, the other dark—near Fort Selkirk July 25. These had a nest that was 60 feet up in a spruce and contained two young able to fly. I saw another nest with the birds about it on an island near the White River July 31.

78. **Archibuteo lagopus.** Rough-legged Hawk.

On September 1, 6, 7, and 9 we saw at St. Michael large hawks which from their proportions and flight were either buteos or archibuteos. Osgood shot one on Whale Island September 8, but could not retrieve it. Mr. Nelson's experience with the hawk family at St. Michael leads me to refer these birds to this species.

79. **Haliæetus albicilla.** Gray Sea Eagle.

Lieutenant Satterlee, of the *Corwin*, found a dead bird of this species at Unalaska October 5, which proved to be a young female.

The wings had been removed at the carpal joint, but the unruffled plumage—the down yet persisting on the ends of the secondaries—removes all probability that it had been a caged bird. This is the first record of the occurrence of this species in western North America, although it is common in Japan and occurs in Kamchatka and occasionally on the Commander Islands.

80. **Haliæetus leucocephalus alascanus.** Northern Bald Eagle.

We found this bird common along the Inside Passage, especially near Wrangell Narrows, and from the steamer I noticed three occupied nests. We visited one which was high in a gigantic dead cedar on a small island near Bocadequadra. Broken shells at the foot of the tree made it probable that the nest contained young. The female parent was secured by Maddren. On the flats of Chilkat Inlet June 1 I saw 28 eagles feeding. Here I found another occupied nest at least 100 feet up in a living spruce (it was so high that heavy charges of No. 4 shot did the bird no harm). A man passing by shot the male with a rifle. The next day I saw the female again on the nest. In the interior this bird is much rarer, though I saw one at Log Cabin June 20, and another at Bennett June 19. We saw the birds occasionally about the lakes (I found a deserted nest on Lake Marsh), and once or twice along the river, the last being observed near the White River July 31.

81. **Falco rusticolus.** Gray Gyrfalcon.

A female was caught in a steel trap set on a post at St. Michael September 21. Its stomach contained feathers. The irides were vandyke brown; tip of bill and nails, black; tarsi, toes, cere, gape, and rest of bill, pearl gray, the bill changing to pearl blue on maxilla near commissure.

82. **Falco peregrinus anatum.** Duck Hawk.

At Fort Selkirk the character of the Yukon Valley changes, and the high, sandy bluffs which have been constantly visible on one bank or the other are frequently replaced by rocky cliffs of varying height. Flying about one of these cliffs near Stewart River July 31 was the first duck hawk we noted. From that point to the Yukon Flats, a few miles above Circle, a day seldom passed without our seeing or hearing them, and from Camp Davidson to Circle I think there was at least one breeding pair every 10 miles. We saw a number of their nests on shelves on the cliffs, but at this time, the first half of August, the young had flown.

Osgood secured a young female August 5 on the cliff known as 'Old Woman,' and an adult female August 7 near the Tahkandik River, and shot several others which he failed to bag. I took a young male from a family on 'Castle Rock' August 5. We found that those taken had been feeding on marsh hawks, Alaska jays, white-winged crossbills, intermediate sparrows, and varied thrushes.

I saw two duck hawks near Nulato August 24, and a tame young bird spent part of the rainy evening of August 30 perched on the back of a chair in the hotel at St. Michael. The cere and bill of the young male were french gray, changing to black on tip of bill and along culmen and cere above; tarsi and toes, pale, grayish green; soles, tarsi behind, and edges of scutellæ in front, yellow; nails, black.

83. **Falco peregrinus pealei.** Peale Falcon.

One flew around the *Corwin* when we were some distance south of the Aleutian Islands and out of sight of land October 7.

84. **Falco columbarius.** Pigeon Hawk.

We saw a pigeon hawk feeding on a large vole near Charlie Creek August 8. Osgood took a young male at a point 12 miles above Circle August 13, and I saw one at the Aphoon mouth August 28.

85. **Falco columbarius richardsoni.** Richardson Merlin.

At Circle August 18 I shot a young female merlin which is intermediate between *columbarius* and *richardsoni*. In general coloring both above and below, it is between typical examples of the two forms and approaches very closely a specimen of *richardsoni* taken by Captain Bendire at Walla Walla, Washington, December 3, 1880, and now in the American Museum of Natural History. My bird has light spots on outer webs of primaries and six light bars on tail similar to those of *richardsoni*, but the bars are narrower and more interrupted. The crop and stomach contained the remains of a red-backed mouse. The irides were vandyke brown; cere, greenish-yellow; maxilla, slate black at tip, changing to greenish-white toward cere and pale french gray at commissure; mandible, pale dull greenish, changing to pale french gray toward tip and commissure; tarsi and toes, straw yellow, the latter inclining toward sulphur yellow; nails, black. Mr. Cantwell writes in the 'Osprey'[1] of having *seen* Richardson's merlin, but does not state that he took specimens. These are the only records for this bird in the Yukon Valley.

86. **Falco sparverius.** American Sparrow Hawk.

We saw this species at Log Cabin June 14, Semenow Hills July 19 and 20, near the Tatchun River July 23, near Fort Selkirk July 26, about 30 miles below Fort Selkirk July 28, and, I think, at Circle August 15. We took specimens on July 19 and 28. This species has not previously been reported from along the Yukon.

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[1] Osprey, III, 25, Oct., 1898.

[*Pandion haliaëtus carolinensis.* American Osprey. While the steamer was anchored near Holy Cross Mission August 25, one of the passengers, Mr. J. F. Burkman, fired at, but failed to get, a large hawk which he was positive was this species. As Mr. Nelson records it from the Lower Yukon, I see no reason to doubt Mr. Burkman's identification.]

87. **Asio accipitrinus.** Short-eared Owl.

We saw a short-eared owl flying overhead at St. Michael on the evening of September 7, and I flushed one from some bushes on Whale Island the next day. September 9 I set three steel traps near St. Michael on poles in the tundra. One of them failed to catch anything, but before September 25 the others yielded 6 short-eared owls and the nails of another. These birds had been feeding on mice and shrews. Osgood shot a short-eared owl at Unalaska October 5. These specimens average slightly *darker*, with the white of the face purer, than fall birds from New England.

88. **Scotiaptex cinerea.** Great Gray Owl.

From some low growth on a steep hillside at Miles Canyon July 11 we flushed a large gray owl that I am confident was this species. We saw a mounted specimen in Dawson August 2 and I was told at Circle that an owl answering the description of this species had been killed there recently.

89. **Nyctala tengmalmi richardsoni.** Richardson Owl.

While lying awake under my mosquito netting in a clearing at the base of the Semenow Hills on the night of July 19 I saw a small, round-headed owl alight on the limb of a dead tree only a few feet away. It flew before I could bring my gun to bear, but I have no doubt it was this species. Osgood took a young bird near Rink Rapids July 22. I was told at Circle that a small owl was common there, and that one had been caught recently.

90. **? Megascops asio kennicotti.** Kennicott Screech Owl.

A reddish-brown owl, of the size and appearance of a screech owl, was seen by Maddren and myself at Caribou Crossing on the afternoon of June 27. We were drawn from camp by its peculiar notes, and saw it fly from a poplar across an opening to a spruce thicket. Later that day Osgood caught a glimpse of another, or perhaps the same bird, as it flew from the top of a small poplar.

91. **Bubo virginianus pallescens.** Western Horned Owl.

Owl pellets, some of them remarkably large, containing chiefly bones of rabbits, ground squirrels, and red squirrels, were found in great abundance, especially at Caribou Crossing and on Windy Island, Lake Tagish, but the most careful hunting failed to disclose the owls.

On Fifty-Mile River, near Lake Marsh July 8, we heard the hooting of a horned owl; and at our camp at Lower Lebarge one flew over, about midnight July 16, and lit in the top of a spruce just out of gunshot. I hurried after it but merely succeeded in seeing the bird swoop into the surrounding gloom.

At our camp near the Tatchun River July 22 one flew by and settled for an instant not far off; and the next day Osgood saw three extremely light-colored horned owls near by. We also heard the hooting of this species near the Yukon at the following places: Near Little Salmon River July 21, 20 miles below Fort Selkirk July 27, 20 miles below the Selwyn River July 29, near the Tatondu River August 6, about 15 miles above Circle August 12, and opposite Circle August 14. In the last case the identification is not without doubt, but the notes of the others were unmistakable.

[*Surnia ulula caparoch.* American Hawk Owl. At Bennett, June 18–22, a bird with a peculiarly weird cry flew about the cliffs above our camp every night. By a process of elimination I have attributed the serenade to this species.]

92. **Ceryle alcyon.** Belted Kingfisher.

This bird occurs about the Yukon lakes, but in small numbers. Osgood saw one at Bennett June 20; I heard one at Caribou Crossing June 29, and saw another on Lake Lebarge July 13.

We found kingfishers fairly common on Fifty-Mile River, and still more common on Thirty-Mile River. As the cliffs replaced the high banks below Fort Selkirk kingfishers became fewer, and none were seen after August 4, when we were about 40 miles below Dawson. Young able to fly were seen near Five-Finger Rapids July 22.

93. **Dryobates villosus leucomelas.** Northern Hairy Woodpecker.

Osgood took a single hairy woodpecker on Fifty-Mile River a few miles above Miles Canyon July 10.

94. **? Dryobates villosus hyloscopus.** Cabanis Woodpecker.

Near the Little Salmon River July 21 I took a young female that corresponded in size and plumage with some young of this subspecies. It was seated in the entrance to a cavity in a burnt spruce. This is the first record of the occurrence of this bird in the Yukon Basin.

95. **Picoides arcticus.** Arctic Three-toed Woodpecker.

On July 1 I was attracted by the loud cries of a young bird, and traced the sound about 100 yards through a spruce grove on the bank of Six-Mile River. The noise proceeded from a full-fledged young woodpecker of this species that had thrust its head out of the opening to its house and kept up a continual screaming. With Osgood's assistance, the nest was opened but only this young bird was found. The entrance was 5 feet 8 inches from the ground, on the lower side of a living, slightly leaning spruce, and the cavity was 10 inches deep. Osgood shot what we both supposed was one of the parents, for it certainly came in answer to the cries of the young; yet this bird proved to be a typical adult male of *P. americanus alascensis.* We saw no other woodpeckers there, except flickers.

96. **Picoides americanus alascensis.** Alaska Three-toed Woodpecker.

Osgood found the remains of an Alaska three-toed woodpecker at Haines June 1, and I shot a laying female near Glacier June 10. In the Yukon Valley we secured one on Six-Mile River; three on Fifty-Mile River above Miles Canyon July 10–11, two of them young adults; two on the Lewes River between Big Salmon and Little Salmon rivers July 20–21, and two at Circle, August 19–20. The young have whiter backs than the adults.

97. **Sphyrapicus ruber.** Red-breasted Sapsucker.

I took an adult male at Skagway May 31, and heard what I suppose was its mate.

98. **Colaptes auratus luteus.** Northern Flicker.

We saw and heard flickers several times at Glacier. One, which Osgood flushed from a hole high in a dead pine June 8, had yellow quills. In the Yukon Valley this is by far the most common woodpecker. We found it quite regularly from Log Cabin to Circle, but, like most Yukon birds, it was shy. At Caribou Crossing June 27 Osgood secured a female and found her nest, containing 8 young and 3 eggs, in a cavity 3 feet from the ground in a partly dead poplar. At Six-Mile River we found a nest about 6 feet from the ground, and at Lower Lebarge July 17 I found 7 well-fledged young in a cavity about 5 feet from the ground in a small dead tree in a burnt tract. July 25 I took a full-grown young near Selkirk.

Adult flickers from Alaska average slightly darker than *luteus* from Canada and farther south, the wings, tail, and bars of upperparts being somewhat blacker, and the light parts more olive and less buffy. Three young—one from near Fort Selkirk, the others nestlings from Lower Lebarge—show this difference in a marked degree, having the wings, tail, and bars of upperparts deep black, and the ground color above smoky olive, instead of buffy olive as in *luteus;* they are even darker than the young of *auratus* from Florida. But the slightness of the difference shown by the adults, the small number of specimens from Alaska, and the possibility that the plumage of the three young may have been discolored by the burnt trees where they were found—though microscopic examination shows no sign of this—make their separation as a subspecies inadvisable at present.

99. **Chordeiles virginianus.** Nighthawk.

From Caribou Crossing, where I shot two females June 27, until after passing the mouth of the Tatchun River July 24, we met with nighthawks on numerous occasions. I took an adult male at White Horse Rapids July 11. These birds were very fat, as might be expected from the abundance of flying insects. They are slightly darker than *virginianus* from the East.

100. **Selasphorus rufus.** Rufous Hummingbird.

We saw a rufous hummingbird on 'Eagle Island' at Bocadequadra May 28. At Glacier Osgood saw one June 6, and on June 10 I found a nest with two slightly incubated eggs 3½ feet from the ground on the branch of a small conifer near the falls of the river. I secured the female, and also one of two males which I saw the same day in the open country below Glacier. On Lake Bennett we saw one opposite West Arm June 24. Mr. George G. Cantwell has already added both this species and *Chordeiles virginianus* to the Yukon avifauna.[1]

101. **Sayornis saya yukonensis.** Yukon Phœbe.

Sayornis saya yukonensis Bishop, Auk, XVII, 115, April, 1900.

Osgood took the type specimen of this phœbe on the heights above Glacier June 8, and I saw one on the mountainside at Bennett June 17. We next met the bird about some cliffs below Fort Selkirk July 26, and after this saw family parties almost daily. Near Stewart River July 31, we saw a pair about their nest on the face of a cliff a few feet above the water. After passing Charlie Creek August 10, we saw no more until we reached Circle, where I killed a young one August 19. Full-grown young were taken July 30. The note is harsh, somewhat resembling that of *Contopus richardsoni*, but louder and shriller. We found the birds only about the cliffs, or the steep, grass-grown banks of the Yukon, a favorite perch being rocks along the shore. Those we met in August seemed to be migrating up the river.

102. **Contopus borealis.** Olive-sided Flycatcher.

At Six-Mile River I took a pair July 1, the female of which had finished laying. A bird which I heard near Bennett June 20, and a large flycatcher which I shot, but could not find, at Caribou Crossing June 25, I believe were this species.

103. **Contopus richardsoni saturatus.** Alaska Wood Pewee.

Contopus richardsoni saturatus Bishop, Auk, XVII, 116, April, 1900.

Osgood took a wood pewee at Skagway May 30, and I two males at Haines June 2. In the Yukon Valley, from Windy Island, Lake Tagish, where I took a male June 30, until we passed Little Salmon River July 21, we often heard this bird's 'pee-ah' coming from the wooded banks. We next saw the bird about 12 miles above Circle, where I took a pair August 14. It was more common at Miles Canyon than elsewhere on the Yukon, and here on July 11 I found an unfinished nest (which resembled that of *C. richardsoni*) in the fork of a half-dead poplar about 10 feet from the ground. No form of wood pewee has previously been recorded from the Yukon.

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[1] Osprey, III, 25, Oct., 1898.

104. **Empidonax traillii alnorum.** Alder Flycatcher.

We first found this species July 26 at Fort Selkirk, where the Pelly River, from the Rocky Mountains, joining the Lewes, forms the Yukon, and hardly lost it again until we reached Circle; later I heard one 15 miles below Fort Yukon on August 21. Wherever we landed we found this or the Hammond flycatcher in the alders and willows. Full-grown young in juvenile plumage were taken on August 5. The adults are apparently typical *alnorum*, having the greener upperparts, more conspicuous wing bars, and shorter bill of this form.

105. **Empidonax hammondi.** Hammond Flycatcher.

We saw several Hammond flycatchers at Skagway, and collected three. I took one at Glacier June 8, and another on a hill above Caribou Crossing June 26. After this we did not again meet with the bird until about 15 miles below Selwyn River, where Osgood shot a young one July 29. From that point to Charlie Creek it was almost equally common with *Empidonax t. alnorum*, frequenting the same localities; but after passing Charlie Creek, August 9, we saw no more of it. The young secured were molting. The male collected at Caribou Crossing is unusually pale for *hammondi*, but this is doubtless the result of wear, as the same thing is shown in *Contopus saturatus* and *Hylocichla alnæ*.

106. **Pica pica hudsonica.** American Magpie.

Maddren saw a pair at Caribou Crossing June 26, and Osgood found their deserted nest. At Fort Selkirk July 26 I took two young—male and female—which had just assumed first winter plumage. They were feeding about the houses of the town. I was told that another young bird had been seen there recently.

107. **Cyanocitta stelleri.** Steller Jay.

Osgood found the remains of a Steller jay in the woods at Haines June 1.

108. **Perisoreus canadensis fumifrons.** Alaska Jay.

We first met this bird at Log Cabin, noted it also at Bennett and Caribou Crossing, and found it common from Lake Marsh to Circle, generally in families. Between White River and Circle it was less common than farther up the Yukon. I saw one 15 miles above Fort

Yukon, heard several at Hendricks Station August 25, and saw one at St. Michael September 18.

Adults had completed the summer molt by July 20; the young were in full juvenile plumage on June 20, and in first winter plumage on August 20. The molt is complete in the adults, while in the young the wings and tail remain unchanged.

The adults collected are all intermediate between *capitalis* and *fumifrons;* each has a black orbital ring, but this is broader in those from Circle. All those in juvenile plumage have the head dull plumbeous, like the back, as in *fumifrons.*

109. **Corvus corax principalis.** Northern Raven.

Of all the birds we met the raven occurred most regularly. On our entire trip down the Yukon hardly a day passed without our seeing the birds in twos and threes. We saw a few at Wrangell, found them more common at Wrangell Narrows, saw several at Skagway, and noticed the wing of one at Glacier. A few were noted across White Pass at Middle Lake and they were abundant at Log Cabin. A flock of at least 200 was observed at the latter place June 20, and another of 50 at Bennett two days later. During September at St. Michael we saw them frequently, but never in large numbers. At Unalaska they were abundant and remarkably tame.

An adult taken on June 20 is in full molt; a young taken July 22 is in juvenile plumage; on one taken August 23 the body feathers of the first winter plumage have replaced most of the juvenile, and the change is complete in one taken September 9.

[*Corvus americanus.* American Crow. I was told by one of the prospectors whom I met on a Yukon steamer that the crow, as well as the northern raven, occurs at the head waters of the Porcupine.]

110. **Corvus caurinus.** Northwest Crow.

Common on 'Eagle Island' at Bocadequadra, where Osgood found a finished but empty nest May 28. Crows were very common near Vancouver June 26, but we saw none after leaving Bocadequadra.

111. **Scolecophagus carolinus.** Rusty Blackbird.

Two blackbirds which I saw at Log Cabin June 15 were probably this species, and I was told that rusty blackbirds had been abundant there a few days before our visit.

Osgood took a specimen near Fort Yukon August 21, and I saw a small flock at the Aphoon mouth August 28. I was informed that these birds breed in large numbers on the tundra by the Kuskokwim and at the head of the Porcupine.

[*Coccothraustes vespertinus montanus.* Western Evening Grosbeak. A prospector told me that a grosbeak, whose description answered that of this species, was common on the Copper River. He assured me it was not the pine grosbeak, which he knew well.]

[*Pinicola enucleator alascensis.* Alaska Pine Grosbeak. A red bird with dark wings—certainly not a crossbill—which I saw at Lake Marsh July 8 was probably a pine grosbeak, but we did not meet with any others during our trip. I was told this bird occurs along the Porcupine.]

112. **Loxia curvirostra minor.** Red Crossbill.

Osgood took a red crossbill and saw another at Unalaska October 5. We did not take any along the Yukon, but I feel positive that a red male crossbill which I shot at Lake Lebarge July 16, but could not find, belonged to this species.

113. **Loxia leucoptera.** White-winged Crossbill.

Crossbills in flocks of from half a dozen to one hundred individuals were often seen from Lower Lebarge to Charlie Village July 16 to August 11. Most of these flocks were probably *leucoptera*, and some certainly were. They were exceedingly restless, and the only ones taken (besides those found in the crop of a duck hawk), were three young at Camp Davidson August 5–6.

114. **Leucosticte griseonucha.** Aleutian Leucosticte.

We saw a number of Aleutian leucostictes on St. George October 3. At Unalaska I saw a flock of about twenty and another of two young October 5, and secured an adult and one of the young. The latter is in juvenile plumage, feathers of the first winter appearing only on the sides of the chest.

115. **Leucosticte tephrocotis littoralis.** Hepburn Leucosticte.

We found this bird only at White Pass Summit, where Osgood took two males and I one female June 13. It is doubtless this species of *Leucosticte* to which Cantwell refers in his paper on the 'Birds of the Yukon Trail.'[1]

116. **Acanthis hornemanni exilipes.** Hoary Redpoll.

I secured two young from a flock about 15 miles above Circle August 13, and Osgood one from a flock at Circle August 19. I saw several at the Aphoon mouth August 27, and we found them rather common in small flocks at St. Michael during September. All taken were young and were molting from juvenile to first winter plumage.

117. **Acanthis linaria.** Redpoll.

We saw several, usually in pairs and very shy, at Bennett June 17. One stopped for an instant on a bush close to our tent. Near Charlie Village I saw a male in high plumage August 11.

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[1] Osprey, III, 25, Oct., 1898.

118. **Spinus pinus.** Pine Siskin.

A very restless family of this species was seen on Windy Island, Lake Tagish, June 30, and Osgood secured one. I saw one at Lower Lebarge July 18, and took one from a small flock near the Selwyn River July 29, and Osgood one from a large flock near Sixty-Mile Creek July 31. We saw a large flock near Dawson August 1, a few near Forty-Mile Creek August 4, and Osgood saw one 15 miles above Circle August 12. Flocks of either this bird or redpolls were heard near the Tatondu River and Charlie Creek August 7–8. I find no former record of this species for the Yukon Valley.

119. **Passerina nivalis.** Snowflake.

At White Pass Summit I shot a female June 12 that had an old fracture of the wing, which had healed in such a manner as to make long flight impossible. I was informed snowflakes had been very abundant there earlier in the year. At St. Michael I saw two September 16, and a flock of about twenty September 19. Osgood took one from a small flock September 25, and I three on September 28.

Snowflakes were common on St. George October 3, but the two young taken (♂ and ♀) are indistinguishable from those from St. Michael, and have bills smaller than the young of *townsendi*.

120. **Calcarius lapponicus alascensis.** Alaska Longspur.

I saw several small flocks at the Aphoon mouth August 27, and secured one specimen. A few were found at St. Michael the last of August, and large flocks there September 1–2. After that several were seen almost every day until September 22, when the last were taken. Osgood saw several at St. George October 3, and I saw one at Unalaska October 5.

121. **Ammodramus sandwichensis.** Sandwich Sparrow.

A few were seen at Unalaska October 5–6, and two young secured.

122. **Ammodramus sandwichensis alaudinus.** Western Savanna Sparrow.

I saw several savanna sparrows on the marshes of Chilkat Inlet June 1, and we took one at Haines, one at Skagway, and two at Glacier. Several pairs were found on the marshes near Log Cabin, a few at Caribou Crossing, and one pair on an island in Lake Tagish. They were fairly common about Lake Marsh, and Osgood found a set of four eggs there, securing the female July 5. After leaving Lake Marsh these sparrows were not seen again until we reached the Alaska boundary, when I took a young August 5. Osgood took a young specimen from a flock near Charlie Village August 10, and young were common at Circle August 14–19. I saw a number at the Aphoon mouth August 27–28, and we found a few at St. Michael up to September 11.

Breeding specimens from the Yukon lake region are indistinguishable in size and color from *alaudinus* from North Dakota. Those from Haines and Glacier are larger in bill and other measurements, slightly darker, and more buffy, but evidently belong to the same form. A male taken at Skagway May 31 is identical in color with a female *savanna* taken in Connecticut about the same date, but in measurements intermediate between *sandwichensis* and *alaudinus*. Young birds from St. Michael and the Yukon below Camp Davidson resemble closely the young of *savanna* in coloring, and have bills slightly shorter and deeper than adult *alaudinus* from the Yukon lakes, but are larger and have longer wings and tails than the latter.

123. **Zonotrichia leucophrys gambeli.**[1] Intermediate Sparrow.

Descending from the bleak, snow-covered rocks of White Pass, we reached at Portage June 14 a country of a more luxuriant vegetation. Here the intermediate sparrow appeared, and it stayed with us constantly until we left Circle, August 20. At Fort Gibbon August 23 I saw one adult and one young. With the exception of the bank swallow, this is the most abundant species inhabiting the Yukon Basin.

At Log Cabin June 20 I took a laying female; on Windy Island June 30 Osgood took a young, able to fly, and at Lower Lebarge I shot one molting into first winter plumage. We found young abundant in this plumage at Circle August 15–20, but saw no adults. This species has two distinct songs. That most often heard is a very mediocre performance, but the other, which I heard in its full perfection only on a hill at Caribou Crossing June 26, and about 2 a. m. on Fifty-Mile River July 9, possesses all the sweetness and clearness of the song of *Z. albicollis*. By July 15 the song season was practically over, but I heard one bird singing as late as August 10.

124. **Zonotrichia coronata.** Golden-crowned Sparrow.

Osgood found the golden-crowned sparrow on the heights above Glacier June 5. It was common at White Pass summit June 11–14, and was the only bird we saw along the trail to Portage June 14. We thought we heard it singing at Log Cabin. The song does not equal those of others of the genus. Osgood found an almost finished nest in a conifer at Summit Lake June 12. It was composed of sticks and moss, lined with grass, and placed about 2½ feet from the ground. The next day I shot a female that contained an egg ready for the shell.

125. **Spizella monticola ochracea.** Western Tree Sparrow.

At Haines I took a female June 2. At Caribou Crossing we took two pairs June 29, one of them with a nest containing three fresh eggs. The nest was buried in the moss at the base of a clump of willows in a willow swamp near the lake, and it was composed of fine, dry grasses, lined with feathers, covered externally with a thick coating of living moss. The eggs, which average 0.80 by 0.57 inches, are pale pea green, heavily mottled over the entire surface with reddish fawn color. At Lake Marsh July 8 I took an adult female, and 15 miles above Circle August 8 a young bird molting from the striped juvenile into the fall plumage. The species was abundant at Circle, and a number were seen on an island 15 miles above Fort Yukon August 21. I saw one at the Aphoon mouth August 27, and noticed seven during September at St. Michael, taking the last September 21.

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[1] This is the species formerly known as *Zonotrichia leucophrys intermedia* Ridgway. See Ridgway, Auk, XVI, 36–37, 1899.

126. **Spizella socialis arizonæ.** Western Chipping Sparrow.

We found this species almost daily from Log Cabin to Dawson, or between June 15 and August 1. In point of numbers it follows the intermediate sparrow and the slate-colored junco. It was last observed about 10 miles below Dawson August 3, but the range of the species may extend much farther north, as a large flock seen near the Selwyn River July 29 showed that the fall migration had begun.

We found a nest with four eggs at Lake Bennett June 24, large young in a nest on Lake Tagish June 30. Young able to fly were met with at Lake Marsh July 5, and a set of three eggs on Thirty-Mile River July 18. The nests were in small spruces, one 4 inches and another about 3 feet from the ground.

Yukon chipping sparrows, females especially, average darker than typical *arizonæ*, but coincide in measurements. Turner reports this species from Fort Yukon.[1]

127. **Junco hyemalis.** Slate-colored Junco.

From Log Cabin to Circle this bird occurs everywhere, contesting with the intermediate sparrow for supremacy in numbers. Two broods are, I think, regularly reared. Females taken at Log Cabin and Bennett had finished laying. On Windy Island June 30 I shot a young bird able to fly, and on the east shore of Lake Tagish the following day saw one pair building a nest and another feeding young. Maddren found a nest with four fresh eggs at Lake Marsh July 4, Osgood one with three fresh eggs at Lower Lebarge July 16, and I one with five young on Thirty-Mile River July 18, and another with four just hatched young near the Tatchun River July 23. By July 20 young in striped plumage were common, and August 2 I took one near Dawson molting into first winter plumage. The slate-colored junco, the intermediate sparrow, and the western chipping sparrow were most common about brush heaps left by lumbermen, weed-grown clearings resulting from forest fires, and cabins of the towns. Every nest found was sunk in the ground to the rim in an open place under a weed or a tussock of grass. One contained a few dark hairs besides the usual fine grass lining. Twenty adults differ from eastern summer specimens of *hyemalis* only in having in both sexes bills averaging 0.02 inch longer (measured from the nostril).

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[1] Contrib. Nat. Hist. Alaska, 174, 1886.

128. **Junco hyemalis oregonus.** Oregon Junco.

Tolerably common at Skagway and more so at Haines. At Skagway I took a female and four fresh eggs May 31. The nest, of dried grass lined with short, white hairs, was sunk in the ground and concealed by dead weeds under a birch only about 30 feet above the water of Lynn Canal.

129. **Junco hyemalis connectens.** Shufeldt Junco.

Maddren took a female at Glacier June 7, a male was taken near White Pass City June 9, and Maddren saw several near there that day. I took a male below Glacier June 10, and saw and heard a number singing a few hundred feet above White Pass City, where the spruce woods gave place to more open country. Their song is quite distinct from that of *oregonus*. This is a new record for Alaska.

130. **Melospiza melodia rufina.** Sooty Song Sparrow.

We heard several singing at Skagway May 31, and Osgood saw some at Haines June 2. At Haines I took a male June 1, and a pair, the female of which had finished laying, June 2.

131. **Melospiza cinerea.** Aleutian Song Sparrow.

Abundant at Unalaska, October 5–7, frequenting the roofs of buildings, lumber piles, wharves, beaches, and weeds of the level country and hillsides. The males were singing constantly, their song having the usual song sparrow character, but not the usual strength or beauty.

132. **Melospiza lincolni.** Lincoln Sparrow.

At Log Cabin June 15 we saw what was apparently a Lincoln sparrow. Osgood took a female and a set of five fresh eggs near Lake Marsh July 5, I another female on the west shore July 8, and we heard several singing near the lake. The nest found was composed of coarse grass lined with fine, and was in a tuft of grass in a swamp, about 4 inches above the water. We again met this species at Lower Lebarge, near Fort Selkirk, near the White River, at Camp Davidson, at Charlie Village, 15 miles above Circle, and at Circle, where one was taken August 19. July 27 a full-grown young was taken, and August 12 one that had almost finished molting into winter plumage.

133. **Melospiza lincolni striata.** Forbush Sparrow.

A Lincoln sparrow which Osgood saw at Haines June 1 should be referred to the northwestern subspecies.

134. **Passerella iliaca.** Fox Sparrow.

A wave of sparrows occured at Circle August 19 just after a frosty night, and among other species I saw a single fox sparrow. The bird was too close to leave identification doubtful.

135. **Passerella iliaca townsendi.**[1] Townsend Fox Sparrow.

Osgood saw one at Skagway, and we noticed several at Glacier which were exceedingly shy. Osgood collected two at Glacier June 8–9, one of which was too badly shot to preserve; the other Mr. Ridgway pronounces somewhat nearer this form than *annectens.*

136. **Petrochelidon lunifrons.** Cliff Swallow.

This species was common at Log Cabin June 15 and 20. At Caribou Crossing we saw a few June 29, probably members of the small colony breeding on the cliffs of an island in Lake Tagish July 1. We next saw cliff swallows near the Hootalinqua River July 19, and from this point to a few miles above Dawson, August 1, we frequently met with colonies of varying size, the largest being near White River. Their nests were attached to cliffs bordering the river, except at Fort Selkirk, where they were breeding under the eaves of houses. Full-fledged young were taken July 25, and I think the absence of this species below Dawson was due to their having already migrated. I was told that both cliff and bank swallows were exceedingly abundant along the Porcupine.

137. **Hirundo erythrogastra unalaschkensis.**[2] Alaska Swallow.

A few were flying over the marshes of Chilkat Inlet June 1; I heard that they were common at White Pass City June 9, and we saw two about the buildings of White Pass Summit June 10. At Log Cabin they were common on June 14, 15, and 20, and on the last date I took a male. A few were noticed at Bennett June 19–21. I refer all seen to this subspecies, for all had remarkably long tails. The single specimen taken had a length of 7.96 inches, wing 4.68 inches, tail 4.10 inches, fork of tail 2.33 inches. The forehead, lower wing-coverts, and abdomen are more highly colored than eastern skins of *H. erythrogastra*, and the shafts of the long tail feathers are whitish.

138. **Tachycineta bicolor.** Tree Swallow.

I saw several at Skagway May 31 and June 3, and over the Chilkat marshes June 1. We saw others near Caribou Crossing June 29; one July 6 and a pair July 7 at Lake Marsh; and several at Miles Canyon July 11. A few miles above Fort Selkirk July 25 I saw several entering and leaving an old flicker hole in a dead spruce.

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[1] Auk, XVII, 30, Jan., 1900.

[2] Rept. Fur-Seal Investigations, 1896–97, pt. 3, 422, 1899.

139. **Tachycineta thalassina.** Violet-green Swallow.

Mr. Cantwell[1] has already added this species to the list of birds known to inhabit the Yukon Valley. We saw a single male among flocks of bank swallows flying over Fifty-Mile River above Miles Canyon July 11 and another between White Horse Rapids and Lake Lebarge. On July 18 I took a male from several that we saw near Hootalinqua, and at the Semenow Hills July 20 Osgood secured a female, finding her nest with four young in a crevice in the cliffs. Maddren shot a young July 28. After this we frequently saw colonies of from six to ten birds of this species, and one near White River that must have contained over fifty.

They were nesting about the cliffs as a rule, but several times we saw them enter holes in banks similar to those of *Clivicola riparia*, while at Fort Selkirk they were nesting in the interstices between the logs of the cabins. We often met with small colonies until within 15 miles of Circle, but after August 5 they kept so high about the cliffs that identification was possible only by their characteristic twitter. The two adult males have green rumps.

140. **Clivicola riparia.** Bank swallow.

We found a small colony nesting at the northern end of Lake Tagish July 1, and a larger one on the west shore of Lake Marsh July 7, but we were entirely unprepared for the great abundance of this species on Fifty-Mile River above Miles Canyon. There almost every bank was honeycombed with their holes. Along the rest of the Yukon as far as Circle bank swallows were common and often abundant, but after August 1 their former presence was generally manifested only by the deserted holes. At Circle I saw about thirty August 17, and a single bird on the following day. Eggs advanced in incubation were found July 7, and by the 22d the young were flying, and all acting as if preparing to migrate. As it grew dusk on the evening of August 5 we watched a large flock which circled over the Yukon, rising higher with each revolution, and at last disappeared toward some mountains due south.

141. **Ampelis garrulus.** Bohemian Waxwing.

We saw several on Six-Mile River July 1, two at Lake Marsh July 7, one on Fifty-Mile River July 10, two pairs (one of which was secured) at Miles Canyon July 11, one at Lower Lebarge July 16, two about a mile apart on Thirty-Mile River July 18, and four near the Selwyn River July 28. We took two adults and three young from a flock of twenty about 15 miles below the Selwyn July 29, and four from a similiar flock near Sixty-Mile Creek July 31. We saw them again at the Chandindu River August 4, Camp Davidson August 5,

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[1] Osprey, III, 25, Oct., 1898.

50 miles above Circle August 11, and 15 miles lower August 12. The female taken July 11, which lacked the wax tips on the secondaries, contained an egg ready for the shell. The young resemble those of *A. cedrorum*, but are grayer, have less white on the abdomen, no pale streaking above, and have the wings, tail, and lower tail-coverts like adult *garrulus*. They lack the cinnamon suffusion of the head of the adult, have only a few black feathers on the throat, a much shorter crest, the wax-like tips of the secondaries peach-blossom pink instead of scarlet, and the lower tail-coverts paler. A still younger bird than the two described is obscurely streaked with whitish both on back and lower parts. On one of the young the wax tips are very small.

In habits and notes the Bohemian waxwing closely resembles the common cedar waxwing. Two males that we noticed while descending Thirty-Mile River were perched on the topmost sprays of tall spruces, uttering a lisping whistle at frequent intervals. One of them flew after a passing insect in the manner of a flycatcher. Flocks were easily approached, and when one bird was shot the rest would scatter, and each would alight on the top branch of some spruce and utter a characteristic call note. This note, which we often heard from passing flocks, was similar to the whistle just mentioned. The birds that we collected had been feeding on the purple berries of some unidentified plant.

142. **Helminthophila celata.** Orange-crowned Warbler.

Osgood took an adult male at Caribou Crossing June 26; I a female and two young 20 miles below Fort Selkirk July 27, and a young near Dawson August 2. Osgood secured an adult and one young at Camp Davidson August 5 and 6, and I saw one young 15 miles above Fort Yukon August 21. All taken were in alders or willows close to the water.

143. **Helminthophila celata lutescens.** Lutescent Warbler.

Common at Haines, where we took five June 1 and 2.

144. **Helminthophila peregrina.** Tennessee Warbler.

Found only at Caribou Crossing, where I heard four males singing and secured three of them June 25 and 27. They were in comparatively open swamps of willows and low spruces.

145. **Dendroica æstiva rubiginosa.**[1] Alaska Yellow Warbler.

I am positive I often heard the song of this species at Bennett June 17–22. I took an adult male at Caribou Crossing June 27, and think I heard the song about Lake Marsh. An adult female was taken by

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[1] Auk, XIV, 76, 123, 1897.

Osgood near the Nordenskiold River July 22, and family parties were often found in the alders and willow thickets between the Pelly River and Circle. I took a young from a small flock 15 miles above Fort Yukon August 21, saw one at the Aphoon mouth August 28, and a few I thought this species at Hendricks Station August 25. Birds from the Yukon Valley do not differ from those of the Alaska coast. A young female is duller above and more buffy below than the young female of *D. æstiva*.

146. **Dendroica coronata hooveri.**[1] Hoover Warbler.

We found Hoover warblers common at Skagway, Glacier, Log Cabin, and Caribou Crossing, and also noted them at Haines, Bennett, Lake Tagish, Miles Canyon, White River, Sixty-Mile Creek, and 12 miles above Circle. At Skagway May 31 they were still in flocks, but at Glacier June 4–10 they seemed to be mated and settled for the summer. At Log Cabin we found a flock June 15, but five days later those still remaining there were beginning to nest. A small flock seen on an island near Sixty-Mile Creek August 1 showed that the return migration had begun. I took a young in striped plumage August 1. Adult males average paler below than typical *D. coronata*, the black markings being narrower, thus giving an effect of broad longitudinal markings rather than black clouding on the chest. Eight specimens of both sexes average slightly larger in length of wing and tail than the corresponding sexes from eastern and central United States. In six males, the exposed culmen averages 0.02 inch longer than in males from Connecticut, but the bill from nostril averages the same, as do both measurements in females. In juvenile plumage *hooveri* is darker than *coronata*, the black markings are broader and blacker, both above and below, and the brownish edgings to the feathers greatly restricted—entirely wanting on the lower parts and middle back.

147. **Dendroica striata.** Black-poll Warbler.

At Log Cabin June 15 this species was common, but on my return June 20 I saw only one pair—which I secured—and one other male. July 5 I took a male at Lake Marsh. Two birds taken at Caribou Crossing are somewhat smaller than average specimens from Dakota and Connecticut.

148. **Dendroica townsendi.** Townsend Warbler.

Osgood took a male at Skagway May 31. At Glacier it was tolerably common in the dense woods of spruce and fir, and unquestionably nesting; altogether we noticed about twenty individuals during our stay. Osgood took an adult at the southern end of Lake Marsh July 1, and I an adult female and young female on the west shore of Lake

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[1] Bull. Cooper Ornith. Club, I, 32, 1899.

Lebarge July 14. The juvenile plumage differs from that of *D. virens* only in being slightly less brown on crown and back. This is a new species for the Yukon Valley.

149. **Seiurus noveboracensis notabilis.** Grinnell Water Thrush.

The first sound that I heard on the morning of August 1, when we were on a small island about 10 miles below Sixty-Mile Creek, was the unmistakable alarm note of the water thrush. This was the first time we had met with this species, and before starting that morning on our daily Yukon drift, Osgood and I each secured a young bird. Near Forty-Mile Creek, Tatondu River, and Charlie Creek water thrushes were again met with. At Circle I saw several August 16–20, took one 15 miles above Fort Yukon August 21, and saw two in a thicket at the Aphoon mouth August 28. The young in fall plumage taken on the Yukon are clove-brown above, including wings and tail—far darker than is usual in *notabilis*—and have darker streaks below.

150. **Wilsonia pusilla.** Wilson Warbler.

Osgood took an adult female near the Chandindu River August 4, and I a young female near Charlie Village August 11 and a young male 25 miles above Circle August 12. I also saw one 30 miles below Circle August 20. These birds, while not typical *pusilla*, are, like those of the Lower Yukon, nearer it than *pileolata.*

151. **Wilsonia pusilla pileolata.** Pileolated Warbler.

We found this the most abundant bird at Glacier June 5–10, frequenting the alder thickets from the valley as far as they extended up the hills. I saw a yellow warbler I thought this species on White Pass Summit June 12. Pileolated warblers were common at Log Cabin, Bennett, and Caribou Crossing, and I am confident I heard them singing at Lake Marsh. Adult males from Glacier resemble normal *pileolata* closely, but have the back rather more green; those from the Yukon Valley, while having the orange forehead and lower parts of this form, have the duller green back of *pusilla.*

[*Motacilla ocularis.* Swinhoe Wagtail. On the morning of August 28 the *Robert Kerr*, on which I was a passenger, was hindered from proceeding by a gale and low water on the bar, and was made fast to the bank at the Aphoon mouth of the Yukon. As I came on deck I saw half a dozen white wagtails fly about the vessel and settle in the grass close by. While I returned for my gun they left, but a thorough acquaintance with *Motacilla alba* in Egypt, where it is abundant during the winter, leaves me no doubt that these birds were wagtails.]

152. **Anthus pensilvanicus.** American Pipit.

A male taken at Skagway June 3 was probably a belated migrant. On the heights above Glacier Osgood saw several June 5, and we found them common at Summit June 11–13. A female taken June 13 was laying, and a fresh but empty nest I found the same day I attributed to this species, no other being near. This nest was loosely formed of fine dry grass in a hollow in the deep moss which covered the almost perpendicular side of a bowlder lying on a hill high above Summit, only a small hole for entrance showing in the moss. We often saw the song-flight at Summit. Launching himself with a sharp preliminary 'chip' from one of the granite bowlders that abound there, the male would rise rapidly to a height of a hundred feet or more, uttering a sweet, clear song. After poising high in air and repeating this song for several minutes the singer would slowly float toward earth and alight 100 yards from where he started, soon to repeat the same performance. We found a pair on the heights above Bennett June 17, and a few, possibly members of one family, at Circle August 15–20.

153. **Cinclus mexicanus.** American Dipper.

We collected a female and set of four fresh eggs at the falls at Glacier June 8. A single ouzel seen farther down the river June 10 was probably the mate of the one taken. Osgood also took one at Unalaska October 5.

154. **Anorthura hiemalis pacifica.** Western Winter Wren.

We noticed a few at Glacier June 4–10, and I took a male there June 6.

155. **Anorthura alascensis.** Alaska Wren.

I saw one at St. George October 3, and we collected five at Unalaska October 5. The young were then molting.

156. **Sitta canadensis.** Red-breasted Nuthatch.

I took a male at Skagway May 31 and another near Log Cabin June 20, and heard one on an island at the junction of the Lewes and Pelly rivers July 26. This species has not heretofore been noted in the Yukon Valley.

157. **Parus atricapillus septentrionalis.** Long-tailed Chickadee.

We took this species at Bennett June 19, west shore of Lake Bennett June 24, Caribou Crossing June 26, Lake Marsh July 7, and Lake Lebarge July 15, but did not notice it again until we reached the Lower Yukon, although chickadees were heard several times whose specific identity was not determined. Thirty miles below Holy Cross Mission I took two August 25, and at the Aphoon mouth I saw a small flock August 28. Young able to fly were taken July 7. One taken August 25 had completed the molt into first winter plumage, while an adult taken the same day was in fresh plumage.

158. **Parus hudsonicus evura.**[1] Yukon Chickadee.

We took the Yukon chickadee at Caribou Crossing June 27, Lake Tagish June 30, Lake Marsh July 5, and Lake Lebarge July 14, and after reaching Thirty-Mile River July 19, found it regularly distributed in families or large flocks all the way to Fort Yukon, 15 miles above which I saw a flock August 21. At St. Michael I took a young female in first winter plumage September 20. Young able to fly were first taken July 5 and molting birds August 13. We took adults in full molt June 27, and one in which the molt was almost completed July 24.

159. **Parus rufescens.** Chestnut-backed Chickadee.

We found a few at Haines and Skagway, and I took one and heard another at Glacier June 5. A female taken at Skagway June 3 had finished laying.

160. **Regulus satrapa olivaceus.** Western Golden-crowned Kinglet.

Tolerably common at Glacier; often heard but seldom seen, and difficult to procure. A female that I took June 10 had the last egg ready for the shell.

161. **Regulus calendula.** Ruby-crowned Kinglet.

I took a male at Log Cabin, and on June 20, between that point and Bennett, heard another singing. Osgood took two young specimens, one at Lower Lebarge July 17, and the other 20 miles below Dawson August 4.

162. **Regulus calendula grinnelli.**[2] Sitka Kinglet.

At Skagway I heard a Sitka kinglet singing May 31, and at Haines took a male and heard another singing June 1. At Glacier I took a male June 6, and during our stay heard two or three others singing. While the Log Cabin bird is normal *calendula*, the Haines and Glacier birds have the more olive back and darker sides of crown of *grinnelli*.

163. **Myadestes townsendi.** Townsend Solitaire.

On the heights above Bennett I took an adult male June 17. On the hot noon of June 26, while seated on the summit of a hill some 1,500 feet above Caribou Crossing, I heard the most beautiful bird song that has ever delighted my ear. It seemed to combine the strength of the robin, the joyousness and soaring quality of the bobolink, and the sweetness and purity of the wood thrush. Starting low and apparently far away, it gained in intensity and volume until it filled the air, and I looked for the singer just above my head. I finally traced the song to a Townsend solitaire that was seated on a dead tree about 150 yards away, pouring forth this volume of melody without leaving its perch. The singer came close enough later to make identification certain.

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[1] Auk, XVII, 118, April, 1900.

[2] Auk, XIV, 399, 1897.

Osgood and Maddren saw one at Lake Lebarge July 14. Osgood took an adult at Miles Canyon July 11, another at the Semenow Hills July 20, a young in the spotted plumage 20 miles below the Selwyn River July 29, and another young 30 miles above the White River July 30. I saw an adult near the Selwyn River July 29, and took a molting adult near Sixty-Mile Creek August 1. Mr. Cantwell found this species in the Yukon Valley.

164. **Hylocichla aliciæ.** Gray-cheeked Thrush.

Several thrushes which we heard singing on the west shore of Lake Marsh July 8 were, I think, this species, as their song differed from that of the dwarf, hermit, and Alma thrushes. I saw two, but they were so shy that I could not secure either. Near Sixty-Mile Creek, July 31, I took a young in spotted plumage, which was with the young of *almæ* which Osgood shot. At Circle I took a young in first winter plumage, also with *almæ*.

165. **Hylocichla ustulata almæ.**[1] Alma Thrush.

This is the common thrush of the Yukon basin, occurring everywhere from Log Cabin to Circle, perhaps in largest numbers at Caribou Crossing and Lake Marsh. Fifteen miles above Fort Yukon I took one, and saw others August 21. We found many nests, usually 6 to 10 feet from the ground in thick growths of young spruces, but none contained eggs. A nest containing four young just hatched, which I found at Caribou Crossing June 25, was about 8 feet from the ground in a thicket of small spruces. The nest resembled that of *H. u. swainsoni.* At Miles Canyon July 11 we saw young able to fly. Osgood took young in spotted plumage July 31, but those taken August 20 had assumed first winter plumage.

They were usually silent by day, but sang frequently during the short nights. At Caribou Crossing, the last of June, their song could be heard constantly from 8 p. m. to 8 a. m., one taking up the strain as another stopped. The song is much superior to that of *Hylocichla aonalaschkæ* and almost equal to that of *H. fuscescens.* It has whispered notes like that of *H. mustelinus.* By the middle of July the song season was practically over, though we heard one of the birds singing July 23. When the nights became really dark in August, I often heard the call-note of this bird near our camp between 2 and 3 a. m.

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[1] Auk, XVII, 119, April, 1900.

166. **Hylocichla aonalaschkæ.** Dwarf Hermit Thrush.

We heard several singing at Skagway, and Osgood took one at Haines June 2. At Glacier they were tolerably common, and we secured several, but they were very shy, keeping in the thickets during the day and singing for several hours in the evening from the topmost spray of some spruce well up the mountainside. Several thrushes' nests in small spruces 6 to 8 feet from the ground were empty, for which condition the abundant red squirrels were probably responsible. At Log Cabin and Bennett we heard a few singing, and at Caribou Crossing Osgood took one June 27.

167. **Hylocichla aonalaschkæ pallasi.** Hermit Thrush.

About 15 miles below Little Salmon River July 22 we secured a pair, whose nest, containing four well-grown young, Osgood had found the evening before. Far from selecting the secluded nesting site usual with this species, this pair had placed their nest between two small bunches of flowers on an open southern hillside, just above a small piece of burnt poplar woodland, and exposed to the full glare of the sun.

168. **Merula migratoria.** American Robin.

Tolerably common at Haines and Skagway, but not found at Glacier. At Haines I took a female and four well-incubated eggs June 2. Robins were common at Log Cabin June 15, and were found regularly, but in gradually decreasing numbers, until August 1, when the last was noted near Sixty-Mile Creek. A flock seen July 29 showed that the southern migration had commenced. We found an empty nest 30 miles below Dawson and heard that the birds bred near Fort Yukon.

Although robins were by no means common at Caribou Crossing, I found, on June 25, 13 empty nests, most of them evidently built that year, and 4 empty nests of the Alma thrush, in a small patch of spruces. The red squirrels which lived in a hollow tree near by probably knew the location of most of these nests. Osgood took a well-grown young robin here on June 26.

169. **Hesperocichla nævia.** Varied Thrush.

At Haines I saw several June 1, and Osgood took one June 2. At Glacier varied thrushes were rather common, but exceedingly shy. About an hour before sunset they would fly to the top of some tall tree and repeatedly utter a long-drawn, plaintive whistle until darkness fell. Sometimes on cloudy days we would hear their song, but it was infrequent and had about stopped when we left Glacier, June 11. We next saw this species near the Tatchun River, where I took a young bird July 23. Thirty miles below Dawson we took young, and met with the birds several times until August 21, when large flocks were seen near Fort Yukon.

At Glacier I found on June 7 a nest containing four eggs, varying from fresh to several days incubated. It was very large, built of sticks and moss and lined with dry grass, and was situated 15 feet from the ground, near the top of a small spruce growing in dense woods a short distance from the river. When I put my hand on the tree, the female flew from the nest with a hoarse, cackling cry and settled a few feet away; the male did not appear. The eggs average 1.25 by 0.84 inches and are nile blue sparingly spotted with écru drab and seal brown.

170. **Saxicola œnanthe.** Wheatear.

Osgood saw two young wheatears at Circle August 19, and secured one. At the Aphoon mouth I shot one on August 27, which fell into the river and was carried away by the rapid current, but I saw the white rump plainly.

171. **Sialia arctica.** Mountain Bluebird.

We found a pair on Fifty-Mile River a short distance above Miles Canyon July 10. The next day I secured the female and found the nest with four well-incubated eggs in a hole about 8 feet from the ground in a dead spruce in the midst of a burnt tract. July 22 I shot a male near the point where Fifty-Mile River empties into Lake Lebarge. Mr. Cantwell also found this species on Fifty-Mile River.

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REVISION OF THE SKUNKS OF THE GENUS CHINCHA

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U. S. Department of Agriculture,
Division of Biological Survey,
Washington, D. C., July 5, 1901.

Sir: I have the honor to transmit herewith for publication as No. 20 of North American Fauna a report entitled "Revision of the Skunks of the Genus *Chincha*," by Arthur H. Howell, assistant in the Biological Survey.

Respectfully,

T. S. Palmer,
Acting Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

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No. 20. NORTH AMERICAN FAUNA. August, 1901.

REVISION OF THE SKUNKS OF THE GENUS CHINCHA.[1]

By Arthur H. Howell.
Assistant, Biological Survey.

INTRODUCTION.

HISTORY.

Skunks have figured in literature since the early part of the seventeenth century. Their peculiar means of defense has served to make them conspicuous, but the repugnance in which they are commonly held has doubtless prevented as thorough study of their habits and characteristics as has been accorded to other common mammals.

Apparently the first account of them is that given by Gabriel Sagard-Théodat in his history of Canada, published in 1636, in which he refers to the ill-smelling qualities of these '*enfans du diable.*'[2] In 1651 Hernandez gave an account of the Mexican skunks, which he confused somewhat with the nasua.[3] It was on this description that Linnæus primarily based his *Viverra memphitis*. Buffon, in 1765, gave a description and figure of a skunk, which he called '*le chinche*'[4]—a name taken from Feuillée, who in 1714, in an account of his travels in South America, had recorded this as the native name of the skunk occurring near Buenos Ayres.[5] Buffon's account has served as the basis for many of the later names applied to the skunks. He ascribes '*le chinche*' to South America, but his figure evidently represents one of the skunks of the genus *Chincha*, which is strictly North American. The confusion of the skunks of the two continents, for which this error is partly responsible, has continued, though in a lessening degree, to the present day.

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[1] *Chincha* of this paper is the equivalent of *Mephitis* of recent authors. For a discussion of the reasons for this change, see p. 14.

[2] Histoire du Canada, p. 748, Paris, 1636.

[3] Thesaurus Rer. Med. Novæ Hisp., p. 332, Rome, 1651.

[4] Histoire Naturelle, XIII, p. 294, pl. 39, Paris, 1765.

[5] Journal du P. Feuillée, p. 272; Paris, 1714.

Schreber, in 1776, gave a good description of the large North American skunk, and his specific name *mephitis* is the first one available for any member of the genus. Cuvier, in 1800, applied the same name in a generic sense to the '*mouffettes*,' his group including both the large and small skunks of North America, since separated into different genera.[1] During the early years of the nineteenth century the large skunks, which form the basis of this paper, were treated by many authors, and some new names were proposed; but for the most part the descriptions are hopelessly confused and the names are unidentifiable. In 1829 Richardson described *hudsonica* from central Canada; in 1832 Lichtenstein named *mesomelas* from Louisiana and *macroura* and *vittata* from Mexico; and in 1837 Gray described *varians* from Texas and *mexicana* (the same as *macroura*) from Mexico.

Up to 1838 the North American skunks had all been included in a single undivided genus, *Mephitis*, but in this year Lichtenstein published an extended revision of the group, in which he classed the white-backed skunks as a subgenus under the name *Thiosmus*, but did not separate the little spotted skunks from their larger relatives.[2] In 1842 Lesson published a brief but important synopsis of the genus, in which he arranged the species in three groups, restricting *Mephitis* in a subgeneric sense to the little spotted skunks, naming the large striped skunks *Chincha* and retaining *Thiosmus* for the white-backed skunks.[3] Lesson's *Mephitis* and *Chincha*, proposed as subgenera, are perfectly tenable as genera, and are here used in that sense, *Mephitis* for the little spotted skunks, commonly known as *Spilogale*, and *Chincha* for the large striped skunks, commonly known as *Mephitis*.

Boitard, in 1842, proposed three new names for the large skunks, all of which probably refer to the same species, though only one, *putida*, is certainly identifiable. This is available for the eastern skunk. In 1857 Baird named the California skunk *occidentalis*. For several decades after this the group received very little attention from systematists, but during the last few years there has been considerable activity in the naming of species. In 1890 *estor* was proposed by Merriam; in 1895, *elongata* by Bangs; in 1896, *scrutator* by Bangs, and *fossidens* and *orthostichus* (fossils) by Cope; in 1897, *holzneri* and *milleri* by Mearns; in 1898, *avia* and *spissigrada* by Bangs, and in 1899, *fœtulenta* by Elliot, and *leptops* and *obtusatus* (fossils) by Cope.

DISTRIBUTION.

The skunks of the genus *Chincha* range over the greater part of North America, from the Hudsonian zone in Canada to Guatemala. The northern limits of their distribution are not definitely known.

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[1] Leçons d'Anat. Comp., I, tabl. 1, 1800.

[2] Abh. Akad. Wiss. Berlin for 1836, pp. 249–312, 1838.

[3] Nouv. Tabl. de Règne Anim., p. 67, 1842.

In the interior they occur as far north as Great Slave Lake, as shown by a specimen from that locality in the U. S. National Museum, and by the statement of B. R. Ross, who says that while he has never seen a living specimen on the Mackenzie River, he has found the bones and part of the skin a short distance from the shores of Great Slave Lake.[1] On the Atlantic coast they have not been recorded north of Nova Scotia. On the Pacific slope the most northerly record is Stuart Lake, British Columbia, though on the immediate coast of the Pacific they are not reported farther north than Howe Sound, in southern British Columbia, and probably do not occur much beyond this point. In the United States they are generally distributed, except in the higher mountains, and in many places are extremely numerous. They are absent or very rare in eastern North Carolina, according to Mr. Outram Bangs,[2] and perhaps the same is true of other small areas within their range.

The subgenus *Chincha* ranges but a short distance into Mexico; *C. estor* reaches southern Chihuahua in the Sierra Madre, *holzneri* enters Lower California, and *varians* occurs in eastern Mexico in the Rio Grande Valley. The subgenus *Leucomitra*[3] occupies nearly the whole of Mexico, and its range overlaps that of the subgenus *Chincha* in southern Arizona. It is chiefly confined to the Sonoran and Transition zones, not occurring in the tropical lowlands except on the coast of Oaxaca. The southern limit of its range is not known, but it probably does not extend beyond the highlands of Guatemala.

HABITS.

The large skunks are wholly terrestrial, living in caves, in the deserted burrows of other animals, or in burrows of their own excavation. They do not avoid the habitations of man, but seem rather to prefer the clearings and pastures about the farm, and frequently make their abode under a house or other building. They are sluggish in movement, and usually show little fear of human beings, depending for safety more on the efficacy of their malodorous discharge than on attempts to escape. Although chiefly nocturnal, they are often seen moving about in the daytime, especially in the morning and evening. They hibernate only during the severest part of the winter, and probably only in northern latitudes.

Their food consists largely of small mammals, reptiles, batrachians, insects, and birds' eggs; and they apparently have no difficulty in securing an abundance, for they frequently become excessively fat. They are particularly fond of insects, and during the seasons when grasshoppers are abundant feed extensively on these pests. In many parts of the United States they have been found useful in destroying the 'white grub,' a great pest in lawns and meadows. Fish and crustaceans, when available, and even carrion or other refuse, are readily eaten. They occasionally rob the poultry yard, but such depredations as they commit are more than offset by their destruction of noxious mammals and insects. Vegetable matter is sometimes eaten. Mr. E. A. Goldman reports that he has found roots and wild fruits in the stomach of a hooded skunk.

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[1] Canadian Nat. and Geol., VII, p. 139, 1862.

[2] Proc. Biol. Soc. Wash., X, p. 139, 1896.

[3] See p. 39.

Skunks have been extensively trapped for furs ever since the settlement of the country by white men,[1] and within the last few years attempts have been made to breed them in confinement; but although 'skunk farms' have been started in several States, the industry seems not yet well established.

EXTERNAL CHARACTERS.

Skunks are too well known to need more than a passing reference to their external appearance. They are stocky animals, particularly heavy behind, with slender nose, small ears, short legs, long fore claws, and long bushy tail. The pelage is long, loose, and silky; the under-fur is quite dense, especially in northern latitudes; and the tail hairs are coarse and flaccid. The colors are black and white, the white usually arranged in a narrow frontal stripe and two na row dorsal bands or one broad band covering the whole back, but the pattern of coloration is subject to much variation. During spring and summer the pelage often becomes much worn and faded, and the glossy black of the winter pelage is frequently replaced by a dull brown. There is apparently but one molt in a year, and this usually occurs in late summer or in autumn.

The females are always smaller than the males and less specialized in their cranial characters, which are often of so little prominence that they do not serve to readily distinguish closely related species. The difference in size is most marked in the larger species. Thus in *Chincha notata* the average length of the skull is 10 percent greater in males than in females, and the average zygomatic breadth 14 percent greater.

The teats usually number 10 to 14. The young are born in litters of from 4 to 10, and reach maturity at a very early age, the bones of the skull completely coalescing before the teeth show any appreciable signs of wear.

That which particularly distinguishes skunks from other animals is their means of defense, consisting of a characteristic malodorous fluid, which, when ejected, speedily disarms the boldest aggressor. The fumes from the fresh liquid are overpowering in their pungency, and are possessed of remarkably penetrating and lasting properties.[1] The fluid is secreted by two anal glands, similar in character to those possessed by other members of the Mustelidæ, but larger and more muscular. Dr. C. Hart Merriam has given a concise description of these glands, as follows:

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[1] During the forty years from 1850 to 1890 the Hudson Bay Company alone shipped over 250,000 skunk skins to England.

> The glands lie on either side of the rectum, and are imbedded in a dense, gizzard-like mass of muscle which serves to compress them so forcibly that the contained fluid may be ejected to the distance of four or five metres (approximately 13 to 16½ feet). Each sac is furnished with a single duct that leads into a prominent, nipple-like papilla that is capable of being protruded from the anus, and by means of which the direction of the jet is governed.[2]

MATERIAL.

The present revision is based chiefly on a study of the specimens in the collections of the U. S. Biological Survey and the U. S. National Museum, supplemented by much additional material from the collection of the American Museum of Natural History, New York, and the private collections of Dr. C. Hart Merriam and Mr. Outram Bangs. The total number of specimens examined exceeds 950, among which are all the existing types. The Biological Survey collection contains good series of skins and skulls of most of the species, and is particularly rich in large series of extra skulls, which have proved of great value in showing the range of individual variation.

My thanks are cordially extended to Dr. C. Hart Merriam for the privilege of using the collections under his charge. Thanks are also due Dr. J. A. Allen and Mr. Frank M. Chapman, of the American Museum of Natural History, Mr. Gerrit S. Miller, jr., of the U. S. National Museum, Mr. D. G. Elliot, of the Field Columbian Museum, Mr. Witmer Stone, of the Academy of Natural Sciences, Philadelphia, and Mr. William Brewster, of the Museum of Comparative Zoology, Cambridge, for the loan of material under their charge. I am especially indebted to Mr. Outram Bangs for the use of a fine series of skunks from his collection, including the types of all his species.

The illustrations in the present paper are from photographs taken by Dr. A. K. Fisher, of the Biological Survey.

One new subgenus (*Leucomitra*) and three new species and subspecies (*Chincha occidentalis major*, *C. occidentalis notata*, and *C. platyrhina*) are here described.

NOMENCLATURE.

Three generic and 35 specific names have been applied to the skunks of this group. The general similarity in external characters among the members of the genus has led to the inclusion of widely different forms under one name, while the extreme variability in some species has multiplied synonyms. The confused state of the nomenclature makes necessary a brief statement of the status of each name.

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[1] For a valuable account of the chemical properties of this fluid see T. B. Aldrich, Journ. Exp. Med., I, pp. 323–340, 1896; II, pp. 439–452, 1897.

[2] Mammals of the Adirondack Region, Trans. Linn. Soc., N. Y., I, p. 76, 1882.

GENERIC NAMES.

Viverra Linnæus, **1758.** Syst. Nat., ed. X, pp. 43–44,

The genus comprehended five species: *V. ichneumon*, *V. memphitis*, *V. putorius*, *V. zibetha* (usually considered the type), and *V. genetta*. The American skunks were referred to it by authors prior to Cuvier, 1800, but it is now restricted to the Old World civets.

Mephitis Cuvier, **1800.** Leçons d'Anat. Comp., I, tabl. 1.

Cuvier proposed this genus to include the '*mouffettes*,' but as no species are mentioned, it is necessary, in order to determine its specific constituents, to refer to his 'Tableau Elementaire,' published two years previously.[1] In this work he places the *mouffettes* as a subgroup of *Mustela*, and mentions two species, *Viverra putorius* Linn. and *V. mephitis* Linn.[2] The latter was removed in 1842 to become the type of the genus *Chincha* Lesson, which leaves *V. putorius*, one of the little spotted skunks, as the type of *Mephitis*. The name *Spilogale*, proposed in 1865 by Gray for the little spotted skunks, will therefore have to be abandoned, becoming a synonym of *Mephitis*, which thus unfortunately proves to be the name of this group of skunks instead of the group for which it has so long been used.

Chincha Lesson, **1842.** Nouv. Tableau Règne Anim., Mamm., p. 67.

Lesson proposed this as the name of a subgenus of *Mephitis*, with *Chincha americana* as the type species; *hudsonica* Richardson is given as a variety, but no other species are placed in the group. The references show that his type species is based on *Viverra mephitis* Erxleben, which in turn is based on *V. mephitis* Schreber—a plainly recognizable species. If we assume (as we can with all propriety) that Cuvier, in placing '*Viverra mephitis* L.' as one of the types of his genus *Mephitis* referred to *V. mephitis* of Gmelin's edition, we then have for the type of *Chincha* a species which is one of the two originally composing the Cuvierian genus *Mephitis*, and one that is likewise identifiable, for *V. mephitis* Gmelin is based on *V. mephitis* Schreber.

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[1] Tabl. Element. de l'Hist. Nat. des Anim., p. 116, 1798.

[2] This name does not appear in either the 10th or 12th editions of Linnæus, so we must assume that the reference is to Gmelin, 1788; *memphitis* of the 10th edition is a different name (see p. 18) and Cuvier's description shows that the animal he had in mind was a skunk, and not the composite species which Linnæus described under the name *memphitis*.

It is perfectly clear, therefore, that Lesson intended to apply the name *Chincha* to the large two-striped North American skunks, and it is used for these in a generic sense in the present paper.

[NOTE.—In a list of names of Mexican animals by A. L. Herrera,[1] '*Mammephitisus macrura*' is used for the '*zorillo*' (the vernacular name of the hooded skunk in Mexico). All of Herrera's names are modified forms of accepted generic names, and until such time as his system shall have been adopted, his names require no consideration.]

SPECIFIC AND SUBSPECIFIC NAMES.

americana (*Mephitis*) Desmarest, **1818.** Nouv. Dict. d'Hist. Nat., Paris, XXI, p. 514.

This name was applied to a composite species, including as varieties all the skunks of North and South America. The first author to use it in a restricted sense was Sabine, who in 1823 applied it to the skunks of Canada.[2] He says that the animals "under examination are the particular sort designated as the *Viverra mephitis* of Gmelin," which is variety No. 7 of Desmarest. The name *americana* therefore becomes a synonym of *mephitis*.

avia (*Mephitis*) Bangs, **1898.** Proc. Biol. Soc. Wash., XII, p. 32.

Under this name Bangs described a form from San Jose, Illinois. It proves to be closely related to *mesomelas*, of which it is considered a subspecies.

bivirgata (*Mephitis americana*) Ham. Smith, **1839.** Jardine's Nat. Libr., Mamm., I, p. 196.

The description under this name probably refers to the eastern skunk (*Chincha putida*), but no type locality is assigned, and the species can not be identified with certainty.

cinche (*Viverra*) Müller, **1776.** Natursyst. Suppl., p. 32.

The species thus named is based on the *chinche* of Buffon, which probably belongs to this genus, but is not certainly identifiable. Müller follows Buffon in ascribing the animal to South America, where *Chincha* does not occur.

concolor (*Mephitis*) Gray (Verreaux MS.?), **1865.** Proc. Zool. Soc. London, 1865, p. 149.

Published by Gray under his 'var. *c. vittata*', with 'Verreaux MS.?' as authority. The form thus named is evidently only one of the many variations to which *vittata* is subject, and although Gray afterwards raised it to subspecific rank[3], the name must be regarded as a synonym.

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[1] Sinonimia Vulgar y Cientifica de los Principales Vertebrados Mexicanos, p. 30, 1899.

[2] Franklin's Narrative of a Journey to the Polar Sea (1819–1822), App., p. 653, 1823.

[3] Cat. Carnivora, Brit. Mus., p. 138, 1869.

edulis (*Memphitis*) Coues (Berlandier MSS.), **1877**. Fur-Bearing Animals, p. 236.

Berlandier (as quoted by Coues) gives a brief description of a skunk from Mexico which is probably *macroura*. The name will stand as a synonym of the latter.

elongata (*Mephitis mephitica*) Bangs, **1895**. Proc. Boston Soc. Nat. Hist., XXVI, p. 531.

Under this name Bangs described the Florida skunk. It proves to be a distinct species, most nearly related to *putida*.

estor (*Mephitis*) Merriam, **1890**. N. Am. Fauna No. 3, p. 81.

The species described under this name by Merriam is a well-marked form inhabiting Arizona and northern Mexico.

fetidissima (*Mephitis*) Boitard, **1842**. Jardin des Plantes, Mamm., p. 147.

Boitard proposed this name on the same page with *olida* and *putida*. The form thus named is probably one of the many variations of the common eastern skunk, but as no more definite type locality is assigned than 'United States,' the name can not be specifically applied.

fœda (*Viverra*) Boddært, **1785**. Elenchus Animalium, I, p. 84.

This is one of the many early names which can not be specifically identified. Boddært quotes Buffon, Schreber, and other early authors, but assigns his species to Mexico.

fœtulenta (*Mephitis*) Elliot, **1899**. Field Columbian Museum, Pub. 32, Zool. Ser., I, no. 13, p. 269.

The form to which this name was applied proves to be practically identical with that to which Bangs had previously given the name *spissigrada*, of which *fœtulenta* is, therefore, a synonym.

fossidens (*Mephitis*) Cope, **1896**. Proc. Acad. Nat. Sci. Phila., p. 386.

This name was applied by Cope to a well-marked fossil species from the Pleistocene bone caves at Port Kennedy, Pennsylvania.

frontata (*Mephitis*) Coues, **1875**. Bull. U. S. Geol. & Geog. Surv. Terr., 2d series, no. 1, p. 7.

The form described by Coues under this name was based on a skull found in the Post-pliocene deposits of Pennsylvania. While the characters assigned to it by him are of slight weight, it differs from the living species in dental characters, and seems worthy of specific recognition.

holzneri (*Mephitis occidentalis*) Mearns, **1897**. Proc. U. S. Nat. Mus., XX, p. 461.

Mearns proposed this name for the form of *occidentalis* occupying southern California and northern Lower California (type locality, San Isidro Ranch). It is a rather poorly marked subspecies that ranges north to the vicinity of Monterey Bay.

hudsonica (*Mephitis americana*) Richardson, **1829**. Fauna Boreali-Americana, I, Mamm., p. 55.

Richardson's name, applied to the skunk of the Northern plains, proves available for the species ranging from Colorado north to the interior of Canada.

intermedia (*Mephitis vittata*, var. *b.*) Gray, **1869**. Cat. Carnivora Brit. Mus., p. 138.

This name is applied to one of the numerous varieties of the hooded skunks due to individual variation. It is a synonym of *vittata*.

laticaudata (*Mephitis*) E. Geoffroy, **1803**. Cat. Mamm. Mus. National d'Hist. Nat., Paris, p. 109.

This name can not be satisfactorily identified. The references indicate that the type specimen belonged to the genus *Chincha*, but the description applies more nearly to one of the South American skunks.

leptops (*Mephitis*) Cope, **1899**. Journ. Acad. Nat. Sci. Phila., 2d series, XI, pt. 2, p. 235.

This name was applied to a fossil species from the Port Kennedy bone caves, Montgomery County, Pennsylvania. I have not had an opportunity to compare it with specimens of recent species.

longicaudata (*Mephitis*) Tomes, **1861**. Proc. Zool. Soc. London, 1861, p. 280.

Under this name Tomes described the form from Dueñas, Guatemala. Specimens from near the type locality have been compared with those of *macroura* and are found to be practically identical.

macroura (*Mephitis*) Lichtenstein, **1832**.[1] Darst. Säugeth., pl. 46, with accompanying text.

Lichtenstein's plate and description are sufficient to identify the species thus named by him, which came from the 'mountains northwest of the City of Mexico.' This is the first name applied to any of the hooded skunks.

memphitis (*Viverra*) Linnæus, **1758**. Syst. Nat., p. 44.

A name applied by Linnæus to an unrecognizable species, evidently part skunk and part nasua. There is nothing in the description to indicate even the genus to which it refers, and it seems best to reject the name as indeterminable. It is quite distinct from *mephitis*, as shown below.

mephitica (*Viverra*) Shaw, **1792**. Museum Leverianum, p. 171.

This name has been generally adopted by recent authors for the eastern skunk, and was restricted by Bangs in 1895 to the northeastern species. Schreber's name *mephitis*, however, is perfectly tenable for the same species, and being of earlier date is adopted instead of *mephitica.*

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[1] The date of publication of that portion of the 'Darstellung' in which the skunks are described is fixed by Lichtenstein himself in a later paper (Abh. Akad. Wiss. Berlin for 1836, p. 303, 1838).

mephitis (*Viverra*) Schreber, **1776**. Säugth., III, p. 444, tab. 121.

Recent authors have rejected this name on the ground that it is preoccupied by *Viverra memphitis* Linn., 1758, supposed to be a misprint for *mephitis.* Through the kindness of Mr. J. E. Harting, of London, who has examined for me a copy of the tenth edition of Linnæus's 'Systema Naturæ' in the Linnæan Society Library, which contains numerous corrections and annotations in the author's own handwriting, sufficient evidence has been brought to light to show that Linnæus intended to write *memphitis*, which must therefore be considered entirely distinct from *mephitis.* In this copy of Linnæus Mr. Harting finds that although certain alterations[1] are made in the diagnosis, the spelling of *memphitis* is not corrected. Still other evidence of the validity of the name is adduced by Mr. Harting, who writes: "That he [Linnæus] meant *memphitis* to stand is clear, not only from his leaving the spelling uncorrected in his annotated tenth edition, but by his rewriting it in a marginal note to his copy of Ray's 'Synopsis Animalium,' 1693, wherein, on p. 181, he identifies it with Ray's '*Yzquiepatl seu Vulpecula.*' Opposite these words he has written '*Viverra memphitis*,' distinctly."

Schreber's name *mephitis*, then, is not preoccupied, and being accompanied by a recognizable description, is adopted as the first name for the Canada skunk.

mesomelas (*Mephitis*) Lichtenstein, **1832**. Darst. Säugeth., pl. 45, with accompanying text.

Lichtenstein's specimen, on which the species thus named is based, was secured from a natural history dealer, and was said to have come from Louisiana. The measurements show it to be the small species inhabiting the southern Mississippi Valley, subsequently named *scrutator* by Bangs.

mexicana (*Mephitis*) Gray, **1837**. Charlesworth's Mag. Nat. Hist., I, p. 581.

Gray's brief description under this name probably refers to one of the forms of *macroura*, of which *mexicana* is therefore a synonym.

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[1] The alterations referred to consist in the substitution for the original diagnosis, of the following:

"*V. alba subtus nigro maculata;*" and the entry in the margin of the query, "*an nasua?*"

The diagnosis as altered agrees with the later portion of the description, and the nasua element is largely removed, although the references point principally to that animal (cf. Bangs, Proc. Boston Soc. Nat. Hist., XXVI, p. 529, 1895).

That Linnæus himself was in doubt as to the validity of the species is shown both by the annotations above mentioned, and by the omission of the name from his twelfth edition.

milleri (*Mephitis*) Mearns, **1897**. Proc. U. S. Nat. Mus., XX, p. 467.

The form thus named was described from Fort Lowell, Arizona. It proves to be a northern race of the hooded skunk, for which this is the only name.

obtusatus (*Mephitis*) Cope, **1899**. Journ. Acad. Nat. Sci. Phila., 2d series, XI, pt. 2, p. 236.

Cope gave this name to an extinct species based on a single jaw discovered in the Port Kennedy bone deposit (Pennsylvania), but his type can not now be found. It is described as a very small species, the size of a weasel.

occidentalis (*Mephitis*) Baird, **1857**. Mamm. N. Am., p. 194.

Under this name Baird described the western skunk. It is a wide-ranging species for which there is no other name.

olida (*Mephitis*) Boitard, **1842**. Jardin des Plantes, Mamm. p. 147.

As in the case of *fetidissima*, described on the same page, this name was probably intended to apply to one of the forms of the eastern skunk, but in the absence of a definite type locality, no specific application can be made.

orthostichus (*Mephitis*) Cope, **1896**. Proc. Acad. Nat. Sci. Phila., p. 389.

Cope described the species thus named from remains found in the Port Kennedy bone caves, Pennsylvania. It appears to be quite distinct from any living species.

putida (*Mephitis*) Boitard, **1842**. Jardin des Plantes, Mamm. p. 147.

This is the first name applicable to the eastern skunk in connection with which the type locality is definitely fixed. Boitard refers to it as '*La Moufette de New Jersey*' and gives a brief description of the animal. The name is adopted for the species long known as *mephitica*.

scrutator (*Mephitis mephitica*) Bangs, **1896**. Proc. Biol. Soc. Wash., X, p. 141.

Under this name Bangs described the form from Louisiana as a subspecies of the Canada skunk. It proves to be quite distinct from the latter, and is a well-marked form, for which, however, Lichtenstein's name *mesomelas*, of much earlier date, must be used.

spissigrada (*Mephitis*) Bangs, **1898**. Proc. Biol. Soc. Wash., XII, p. 31.

The form thus named was described by Bangs from Sumas, British Columbia. It proves to be a northern race of *occidentalis*.

varians (*Mephitis*) Gray, **1837**. Charlesworth's Mag. Nat. Hist., I, p. 581.

The description of the form thus named is inadequate, and the type locality ('Texas') indefinite, but Gray's statement in a later paper that the tail is as long as the body fixes the name to the large skunk of southern and western Texas. The type specimen can not be found.

vittata (*Mephitis*) Lichtenstein, **1832.** Darst. Säugeth. plate 47, with accompanying text.

Lichtenstein described under this name the species found at San Mateo del Mar, Oaxaca, Mexico. It proves to be a well-marked form of the hooded skunk group.

Genus CHINCHA Lesson.

Generic characters.—Skull highly arched, highest in frontal region; rostrum truncated with slight obliquity; posterior margin of palate nearly on a line with posterior border of last molars; periotic region not inflated; mastoid and paroccipital processes prominent; post-orbital processes not prominent; coronoid process of mandible conical, erect. Dental formula: $i. \frac{3-3}{3-3}, c. \frac{1-1}{1-1}, pm. \frac{3-3}{3-3}, m. \frac{1-1}{2-2}=34$. Snout not greatly produced; nostrils lateral; tail long and bushy.

The genus *Chincha* is a member of the subfamily Mephitinæ, which also includes three other genera, *Mephitis*, *Thiosmus*,[1] and *Conepatus*, of which only the first two occur in North America. *Mephitis* may be readily distinguished by the color pattern, which consists of numerous white stripes (always more than two) broken into many patches or spots. *Thiosmus* differs from the other two North America genera in having the snout produced, and bare for a considerable distance from the tip, with the nostrils inferior; tail short and sparsely haired; and usual color pattern black, with a solid white band covering the entire back and part or all of the tail.

Key to species and subspecies.

[Based on adult males.]

Audital bullæ greatly inflated; back usually either wholly black or wholly white .... (Subgenus *Leucomitra*, p. 39)
Smaller; bullæ much inflated .... *vittata* (p. 43)
Larger; bullæ less inflated.
Tail much longer than body .... *milleri* (p. 42)
Tail not longer than body .... *macroura* (p. 41)
Audital bullæ not greatly inflated; back usually with a white stripe, divided posteriorly .... (Subgenus *Chincha*, p. 22)
Palate with prominent spine.
Tail longer than body .... *elongata* (p. 27)
Tail shorter than body .... *putida* (p. 25)

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[1] *Thiosmus* Lichtenstein, Abh. Akad. Wiss. Berlin for 1836, p. 270, 1838. Material in the collection of the Biological Survey indicates that *Conepatus* Gray, described from Patagonia, will have to be separated from the white-backed skunks usually known under this name. The white-backed skunks will, in such event, require another name; and since *Thiosmus* Lichtenstein seems to be the earliest one that is available, it is here provisionally adopted for this group.

- Palate without prominent spine.
  - Tail less than half the length of body .... *mephitis* (p. 22)
  - Tail more than half the length of body.
    - Tail usually more than 350 mm. (Texas) .... *varians* (p. 31)
    - Tail usually less than 350 mm.
      - Skull small (basilar length[1] less than 66 mm.).
        - Body stripes very broad .... *estor* (p. 32)
        - Body stripes narrower.
          - Tail more than 250 mm .... *holzneri* (p. 38)
          - Tail less than 250 mm.
            - Skull smaller (basilar length usually under 60 mm.). *mesomelas* (p. 29)
            - Skull larger (basilar length usually over 60 mm.) .... *avia* (p. 30)
      - Skull large (basilar length more than 66 mm.).
        - Body stripes narrow; frequently not continuous .... *notata* (p. 36)
        - Body stripes broad; always continuous.
          - Tail usually more than 285 mm.
            - Skull very broad (mastoid breadth more than 45 mm.) .. *major* (p. 37)
            - Skull narrower (mastoid breadth less than 45 mm.).
              - Rostrum very broad (breadth across post-orbital processes more than 24 mm.) .... *platyrhina* (p. 39)
              - Rostrum narrower (breadth across post-orbital processes less than 24 mm.) .... *occidentalis* (p. 34)
          - Tail usually less than 285 mm.
            - Palate extending back of last molars .... *hudsonica* (p. 24)
            - Palate ending on a line with last molars .... *spissigrada* (p. 35)

List of Species and Subspecies, with Type Localities.

Subgenus CHINCHA.

Species and subspecies.	Type localities.
Chincha mephitis (Schreber)	America (restricted to eastern Canada).
hudsonica (Richardson)	Plains of the Saskatchewan.
putida (Boitard)	New Jersey.
elongata (Bangs)	Micco, Brevard County, Florida.
mesomelas (Lichtenstein)	Louisiana.
mesomelas avia (Bangs)	San Jose, Illinois.
mesomelas varians (Gray)	Texas.
estor (Merriam)	San Francisco Mountain, Arizona.
occidentalis (Baird)	Petaluma, California.
occidentalis spissigrada (Bangs)	Sumas, British Columbia.
occidentalis notata nobis	Trout Lake, Mount Adams, Washington.
occidentalis major nobis	Fort Klamath, Oregon.
occidentalis holzneri (Mearns)	San Isidro Ranch, Lower California.
platyrhina nobis	South Fork Kern River, California.

Subgenus LEUCOMITRA.

Chincha macroura (Lichtenstein)	Mountains northwest of City of Mexico.
macroura milleri (Mearns)	Fort Lowell, Arizona.
macroura vittata (Lichtenstein)	San Mateo del Mar, Oaxaca, Mexico.

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[1] Basilar length of Hensel, measured from inferior lip of foramen magnum to posterior rim of alveolus of middle incisor.

Subgenus CHINCHA. Large Striped Skunks.

Subgeneric characters.—Skull (Pls. V, VI, and VII) long and relatively narrow interorbitally; zygomata usually spreading broadly; interpterygoid fossa broad; palate ending either squarely or with a median notch or spine; audital bullæ not greatly inflated; anterior palatine foramina usually small and narrow; mastoids, and sagittal and supraorbital crests well developed. Size medium to large; build heavy; soles broad; ears not prominent; fur dense.

The usual color pattern is as follows: A narrow median white stripe extends from nose to nape; a white dorsal band beginning with a broad nuchal patch, and narrowing between the shoulders, divides into two lateral stripes, which continue to the tail and sometimes down its sides; the rest of the body is black; the tail is of mixed black and white hairs, the white ones much the longer; all the tail hairs are white at the base. (See Pl. II, fig. 1.)

Great variability is exhibited by the species inhabiting the eastern United States—*putida*, *elongata*, and *mesomelas*—which grade in color pattern from specimens wholly white above, including the tail, to specimens in which the only white areas are the frontal stripe and a dash on the nape. In the western species and in *C. mephitis* from Canada the variability is slight, and consists chiefly in the breadth of the body stripes and the amount of white on the tail. (See Pls. I, II, and III.) The white areas are often of a creamy hue, and are never mixed with black hairs, as they are in the hooded skunks (subgenus *Leucomitra*), and specimens in the black phase never show any trace of the white on the sides that is usual in the black phase of *Leucomitra*.

Descriptions of Species and Subspecies.

CHINCHA MEPHITIS (Schreber). CANADA SKUNK.

Viverra mephitis Schreber, Säugth., III, p. 444, tab. 121, 1776.
Viverra mephitica Shaw, Mus. Leverianum, p. 171, 1792 (part).
Viverra mephitis Oken, Lehrbuch der Naturg., p. 994, 1816.
Chincha americana Lesson, Nouv. Tabl. Règne Anim., Mamm., p. 67, 1842.
Mephitis mephitica Bangs, Proc. Boston Soc. Nat. Hist., XXVI, p. 533, 1895; Elliot, Synop. Mamm. N. A., Field Columbian Museum, Zool. Ser., II, p. 322, 1901 (part).

Type locality.—America.

Geographic distribution.—Eastern Canada—Nova Scotia, Quebec, and northern Ontario; west and north at least to Oxford House, Keewatin.

General characters.—Size large; *tail short and slender*, mixed black and white; markings constant; skull large and massive; palate ending in an even curve, *without notch or spine.*

Color.—The color pattern, which is quite constant, agrees with that described in the subgeneric diagnosis (p. 22). The white stripes are never very broad and are sometimes separated for their entire length, as in *C. notata.* They extend down the sides of the tail and project beyond its tip. (See Pl. II, fig. 1.)

Cranial characters.—Skull large and massive; *rostrum broad;* zygomata heavy, *not greatly expanded; mastoid processes not prominent;* braincase very broad; palate ending in an even curve, *without distinct notch or spine;* posterior border of palate usually slightly back of posterior alveoli of last molars. (See Pl. V, figs. 1 and 2.)

Measurements.[1]—Average of 7 adult males from Canada:[2] Total length, 613; tail vertebræ, 188; hind foot, 78. Average of 2 adult females from Canada:[2] 578; 165; 70. *Skull:* (See table, p. 44).

General remarks.—Until quite recently the specific name *mephitica* has been applied indiscriminately to all the skunks of eastern North America. In 1895, Mr. Outram Bangs[3] restricted the name to the form inhabiting the Hudsonian and Canadian zones,[4] and pointed out the characters which distinguish it from its congeners. Schreber's name *mephitis*, which has sixteen years' priority over Shaw's name *mephitica*, is strictly applicable to the Canada skunk (as shown by Bangs), since the tail is said to be half the length of the body, a proportion not found in any other of the eastern species. The specific name *mephitis* has been rejected by all recent authors on the ground that it is preoccupied by *Viverra memphitis*, Linn.; but as shown in the remarks on nomenclature (p. 18), the two names are quite distinct.

The Canada skunk is a large, stocky animal with a heavy skull and a very short tail that narrows gradually to the tip. It is most nearly related to *hudsonica* of the western plains, from which it differs in the slender tail, as well as in skull characters. From *putida* of the Atlantic States it differs in larger size, shorter tail, and constancy of markings. Skulls of females are considerably smaller than those of males, and are equaled in size by skulls of males in *putida*, but in other respects they maintain the characters assigned to the species.

Specimens examined.—Total number, 13, from the following localities:

Nova Scotia: Annapolis, 1; Digby, 1; Halifax, 1.
Quebec: Lake Edward, 4.
Ontario: Moose Factory, 1; North Bay, Lake Nipissing, 2; Little Pic River, Lake Superior, 1.
Keewatin: Oxford House, 1; Pine Lake, 1.

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[1] All measurements are in millimeters.

[2] *Fide* Bangs.

[3] Proc. Boston Soc. Nat. Hist., XXVI, p. 533, 1895.

[4] Examination of a large number of specimens from northern New York and New England shows that *putida* is the form occupying the greater part of the Canadian zone.

CHINCHA HUDSONICA (Richardson). NORTHERN PLAINS SKUNK.

Mephitis americana, var. *hudsonica* Richardson, Fauna Boreali-Americana, I, Mamm., p. 55, 1829.

Mephitis mephitica, var. *occidentalis* Merriam, Ann. Rep. U. S. Geol. Surv. for 1872, p. 662, 1873.

Mephitis mephitica hudsonia Elliot, Synop. Mamm. N. A., Field Columbian Museum, Zool. Ser., II, p. 322, 1901 (part).

Type locality.—Plains of the Saskatchewan.

Geographic distribution.—Western Canada, from Manitoba to British Columbia (east of the Cascades); south in the United States to Colorado, Nebraska, and Minnesota.

General characters.—Size very large; *tail heavy* and of medium length, *ending in a blunt brush without a white pencil;* skull heavy, with a long palate; *zygomata broadly spreading.*

Color.—This species exhibits the usual color pattern of skunks of this group. The white stripes are of medium width, bifurcate just behind the shoulders, and extend nearly to the tip of the tail. The tail, which is very full and bushy, usually ends in a blunt, black brush, and has an indistinct band of white about two-thirds of the distance from the root to the tip.

Cranial characters.—Compared with *mephitis:* Skull both longer and broader; *zygomata very widely expanded;* mastoid processes prominent; *palate long*, ending behind plane of posterior molars, without notch or spine; interorbital constriction marked; nasals and ascending branches of premaxillæ short; dentition heavy, the lower carnassial relatively large. (See Pl. VI, figs. 1 and 2.)

Measurements.—Average of three adult males from Saskatchewan, Montana, and Wyoming: Total length, 726; tail vertebræ, 268; hind foot, 82. Average of 3 adult females from Montana and Idaho, 602; 250; 71. *Skull:* (See table, p. 44).

General remarks.—This skunk may be readily distinguished from the skunks of the eastern States by its large size and bushy tail without a distinct white pencil. Compared with *mephitis*, its nearest ally, it has a longer and heavier tail, broad, heavy soles, and a skull of quite different proportions. The most noticeable difference between the skulls of the two species is in the widely spreading zygomata of *hudsonica* and the contracted mastoids of *mephitis*. The skull of *hudsonica*, viewed from above, appears narrower than that of *mephitis* in the frontal and parietal regions. It resembles that of *occidentalis* in general shape, but has more widely expanded zygomata. Typical *hudsonica* may be distinguished from both *varians* and *occidentalis* by the short ascending branches of the premaxillæ.

The species has an extensive range on the northern plains, and spreads over most of the northern portions of the Rocky Mountains from Colorado to British Columbia. Its range meets that of *mephitis* in Manitoba, and the two species may possibly intergrade, though present material does not fully show that such is the case. Specimens from British Columbia have slightly shorter tails, but in other respects are typical.

A large series from Arkins, Colorado, consisting of skulls and a few skins, show that two species are present in that region. Of 31 skulls of adult males, 16 are fairly typical *hudsonica*, 12 are just as typical *varians*, and 3 are indeterminate. It is not difficult to separate them, the *hudsonica* series having broad, heavy skulls, with spreading zygomata and long palates, the *varians* series much slenderer and narrower skulls, with shorter palates. No skins of the *hudsonica* form are available, but those of the *varians* form are typical, except that they have the shorter tails usual in specimens of *varians* from the northern part of its range. Under these rather unusual conditions it seems hardly possible to consider that the two species intergrade, but rather that their ranges overlap at this point, each remaining distinct, save for an occasional hybrid.

Specimens examined.—Total number, 80, from the following localities:

Mackenzie: Great Slave Lake, 1.
Saskatchewan: Wingard, 1.
Alberta: Jasper House, 1.
British Columbia: Shuswap, 6; Sicamous, 4; Ashcroft, 1; Okanagan, 4; Kamloops, 1; Stuart Lake, 2; Ducks, 1.
Washington: Fort Spokane, 1.
Idaho: Bear Lake (east side), 1; Cœur d'Alène, 1.
Montana: Stanford, 1; Great Falls, 1; St. Marys Lake, 1; Nyack, Teton Mountains, 1; Bear Paw Mountains, 3; Prospect Creek, near Thompson, 1; Tobacco Plains, 2; Yellowstone River, (26 miles from mouth), 1.
Wyoming: Rona, Sheridan County, 1; Lower Geyser Basin, 1; Shoshone Lake, 1; Fort Bridger, 1; Big Horn Mountains, 1; Bull Lake Creek, Fremont County, 1; Fort Laramie, 1.
Colorado: Arkins, Larimer County, 19 (skulls).
Nebraska: Johnstown, 1.
South Dakota: Custer, 1; Fort Pierre, 1; Fort Randall, 1; Fort Sisseton, Marshall County, 1; Rapid City, 1.
Minnesota: Elk River, 9; Fort Snelling, 1; Roseau River, at Point d'Orme, 1; Bois de Sioux, 1.

CHINCHA PUTIDA (Boitard). EASTERN SKUNK.

Mephitis putida Boitard, Jardin des Plantes, Mamm., p. 147, 1842.
Mephitis olida Boitard, Jardin des Plantes, Mamm., p. 147, 1842.
Mephitis fetidissima Boitard, Jardin des Plantes, Mamm., p. 147, 1842.
Mephitis mephitica Baird, Mamm. N. Am., p. 195, 1857 (part); Elliot, Synop. Mamm. N. A., Field Columbian Museum, Zool. Ser., II, p. 322, 1901 (part).
Mephitis varians, var. *b. mephitica*, Gray, Cat. Carnivora Brit. Mus., p. 137, 1869.
Mephitis varians, var. *e. chinga*, Gray, Cat. Carnivora Brit. Mus., p. 137, 1869.

Type locality.—New Jersey.

Geographic distribution.—New England and Middle Atlantic States; south to Virginia; west to Indiana.

General characters.—Size medium; tail longer than that of *mephitis*, black, *with a distinct white pencil;* skull short and relatively broad zygomatically, *with a prominent spine on the palate.*

Color.—This species exhibits the usual color pattern of the skunks of this group, with considerable variation in the breadth and extent of the white stripes. The tail is usually wholly black, excepting a white pencil, which extends from 100 to 150 mm. beyond the end of the vertebræ. The white stripes are usually broader than in *mephitis*, and specimens frequently occur in which the back is almost wholly white. In many individuals, however, the stripes are much reduced both in length and breadth, and occasionally are entirely wanting, the white being confined to a small patch on the nape and the usual frontal stripe. Only two individuals in the large series examined have the white stripes continued down the sides of the tail. (See Pl. I, fig. 1.)

Cranial characters.—Skull of medium size and *relatively broad across zygomata;* interorbital constriction marked; *posterior border of palate with a prominent spine;* palate usually ending about on a line with last molars; *mastoid processes prominent.* (See Pl. V, figs. 3 and 4).

Measurements.—Average of 6 adult males from Hastings, New York: Total length, 575; tail vertebræ 229, hind foot 60. Average of 6 adult females from same locality: 603; 223; 62. *Skull:* (See table, p. 44).

General remarks.—This species, the common skunk of the Eastern States, is generally distributed from Maine to Virginia, but reaches the Mississippi Valley only, so far as known, in Ohio and eastern Indiana. It has long borne the specific name *mephitica*, which until recently it shared with all its congeners in eastern North America; but since this is a synonym of *C. mephitis* (Schreber), which is here adopted for the Canada skunk, it becomes necessary to select the next available name. While a great many names were proposed in the early years of the present century for the American skunks, the earliest used in a sufficiently restricted sense to be available for the present species is *putida* of Boitard, proposed in 1842 for the skunk of New Jersey. There is but one species of skunk in New Jersey; hence, although Boitard's description is not in itself sufficient for identification, no doubt can exist as to the applicability of the name. The two other names (*olida* and *fetidissima*) proposed by him on the same page probably apply also to this form, but these are also inadequately described and lack the specific mention of a type locality.

In 1896 Bangs described a new form from Louisiana under the name *Mephitis mephitica scrutator* (=*mesomelas*), and expressed the opinion that the skunks inhabiting the New England and Middle Atlantic States are intermediates between it and *mephitica* (=*mephitis*).[1] A careful study of a large number of specimens from eastern North America, including Bangs's types, shows that the skunks of the Atlantic coast States are very distinct from those inhabiting the

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[1] Proc. Biol. Soc. Wash., X, pp. 139–144, 1896.

Mississippi Valley, and that the form from New England and the Middle Atlantic States is also quite distinct from *mephitis*. Hence it is entitled to separation as a full species.

It may be at once distinguished from *mephitis* by its longer tail and very different skull. The skull is not only much smaller and weaker than that of *mephitis*, but the relatively great breadth across the zygomata and the marked interorbital constriction give it a very different appearance. The skulls of some of the largest males are almost as broad zygomatically as those of *mephitis*, though very much shorter. The spine on the posterior border of the palate, which is a fairly constant character (absent in only a very few individuals in the large series examined), distinguishes *putida* alike from *mephitis* and from *mesomelas* and its subspecies *avia*. The presence of a palatal spine, the great mastoid breadth, and other differences in the skulls of males of this species, as compared with those of *avia*, whose range meets that of *putida* in Indiana, show that the two forms are quite distinct. Skulls of females, however, have the spine on the palate less pronounced, the zygomata less abruptly spreading, and the mastoid processes reduced, and thus resemble rather closely the females of *avia*.

As in all the skunks, the skulls of the females of *putida* are very much smaller than those of the males, although occasionally the skull of a very large female will equal that of a small male. The skulls show a large amount of individual variation, particularly in size but also in other respects. Specimens from New Hampshire and northern New York average larger than the typical form, which might be regarded as due to the influence of *mephitis* but for the complete absence of other signs of intergradation with that species.

Specimens examined.—Total number, 182, from the following localities:

New York: Adirondack Mountains, 51 (skulls); Lake George, 10; Tomhannock, 1; Locust Grove, 11; Severance, 13 (skulls); Catskill Mountains, 1; Hastings-on-Hudson, 16; Highland Falls, 3; Big Moose Lake, Hamilton County, 1; Mayville, 2; Westchester County, 1; Sing Sing, 3; Montauk Point, 2; Shelter Island, 19 (skulls); Miller Place, Suffolk County, 2.
New Hampshire: Ossipee, 8.
Maine: Bucksport, 1; Brooklin, 2.
Massachusetts: Wilmington, 15; Burlington, 2; Taunton, 1; Ipswich, 1; Woods Hole, 2.
Connecticut: East Hartford, 3.
Pennsylvania: Carlisle, 1.
Ohio: Garrettsville, 1.
Indiana: Marion County, 3; Boone County, 1; Denver, 1.
Maryland: Jefferson, 1.
District of Columbia: Washington, 3.

CHINCHA ELONGATA (Bangs). FLORIDA SKUNK.

Mephitis mephitica elongata Bangs, Proc. Boston Soc. Nat. Hist., XXVI, p. 531, 1895.
Mephitis elongata Bangs, Proc. Biol. Soc. Wash., X, p. 142, 1896.

Type locality.—Micco, Brevard County, Florida.

Geographic distribution.—Florida (from vicinity of Lake Worth) to North Carolina, and in the mountains to West Virginia; west on the Gulf coast to the Mississippi River.

General characters.—Size medium; *tail very long*, marked with white on the sides, and with a long white pencil; markings variable, but white stripes usually very broad; skull peculiar—larger than that of *putida*.

Color.—Markings similar to those of *putida*, but white stripes averaging broader (about 45 mm. in width) and bifurcating about the middle of the back; tail mostly white above and on the sides, this color reaching around and almost meeting beneath the root of the tail. Great variability in markings is exhibited, some specimens being wholly black, save for a few irregular white patches on the shoulders, others nearly all white above, including the tail, and mixed with white below. (See Pl. I, figs. 2 and 3.)

Cranial characters.—Skull larger and heavier than that of *putida; highly arched in frontal region; rostrum very broad;* anterior palatine foramina large; zygomata spreading less abruptly; dentition heavy, lower carnassial especially large; audital bullæ rather large; spine on palate prominent; interpterygoid fossa broad.

Measurements.—Average of 2 adult males from type locality: Total length, 703; tail vertebræ, 317; hind foot, 74. Average of 2 adult females from St. Marys, Georgia: 710; 315; 73. A series from Lake Harney and Mullett Lake are somewhat smaller, 3 adult males averaging 689; 292; 64. *Skull:* (See table, p. 44.)

General remarks.—The Florida skunk is closely related to *putida*, but is very distinct from *mesomelas* of the lower Mississippi Valley, from which it may be distinguished by its long tail and heavy skull. It was described by Bangs as a subspecies of the eastern skunk, but in a later paper he accorded it specific rank, and stated that its range does not meet that of *mephitica* (=*putida*) on the Atlantic coast, since the coastal region of North Carolina is practically uninhabited by skunks. More recently Mr. Bangs has received a specimen of *elongata* from Raleigh, North Carolina, the only one, so far as known, ever taken in the eastern part of the State. Two specimens from West Virginia are typical except that the tail is not quite the usual length—a character found occasionally even in specimens from Florida.

Specimens examined.—Total number, 39, from the following localities:

Florida: Micco, 2; New Berlin, 2; Blitches Ferry, Citrus County, 3; Lake Harney, 5; Mullett Lake, 5; Gainesville, 1; Sebastian, 1; Fort Kissimmee, 3; Lake Worth, 1; Hernando County, 1.
Alabama: Baldwin County, 2.
Mississippi: Bay St. Louis, 2.
Georgia: St. Marys, 2; Pinetucky, 2; McIntosh County, 1; Nashville, 1.
North Carolina: Raleigh, 1; Weaverville, 2.
West Virginia: Green Bank, 1; Travellers Repose, 1.

CHINCHA MESOMELAS (Lichtenstein). LOUISIANA SKUNK.

Mephitis mesomelas Licht., Darst. Säugeth., pl. 45, fig. 2, with accompanying text, 1832.
Mephitis mephitica scrutator Bangs, Proc. Biol. Soc. Wash., X, p. 141, 1896; Elliot, Synop. Mamm. N. A., Field Columbian Museum, Zool. Ser., II, p. 324, 1901.

Type locality.—Louisiana.

Geographic distribution.—West side of Mississippi Valley from southern Louisiana to Missouri; westward along the coast of Texas to Matagorda Island; and up the Red River Valley as far at least as Wichita Falls.

General characters.—*Size very small;* tail short, usually wholly black; skull small and relatively narrow.

Color.—More variable than *varians*, but apparently less so than *putida*. In specimens from the type locality the white stripes are narrow, and usually terminate about the middle of the back, though they occasionally extend to the root of the tail;[1] tail usually wholly black; the white pencil generally absent, but if present, shorter than in *putida*. (See Pl. II, fig. 2.) In specimens from Texas the stripes usually reach to the tail, and the coloration is more constant.

Cranial characters.—*Skull very small and relatively narrow; mastoids contracted;* palate ending squarely, *without distinct spine;* teeth small; audital bullæ usually more inflated than in *putida*. (See Pl. VI, figs. 3 and 4.)

Measurements.—Average of 4 adult males from Louisiana: Total length, 576; tail vertebræ, 223; hind foot, 63. Average of 3 adult females from same localities: 566; 224; 62. Average of 4 adults (both sexes) from Marble Cave, Missouri: 628; 232; 67. *Skull:* (See table, p. 44.)

General remarks.—In Lichtenstein's original description of this species he remarked that his type was secured from a natural history dealer, and was said to have come from Louisiana. In a later paper[2] he gave its range as '*Ludoviciana et ad Missouri fluvium.*' By reason of his assignment of a definite type locality, and by the aid of the measurements of his specimen,[3] we are able to apply the name with certainty to the small species inhabiting the lower Mississippi

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[1] Lichtenstein figures a specimen in which the white stripes reach to the tail and down its sides. None of those examined from Louisiana have as much white as this specimen, but it is stated by Mr. Levi Spalding, of Iowa, Louisiana, that all gradations of color occur in the skunks of that section. When more specimens are obtained from the State, many individuals will probably be found that agree perfectly with the figure of the type.

[2] Abh. Akad. Wiss. Berlin for 1836, p. 277, 1838.

[3] His measurements are: Head and body, 1 ft. 7 in.; tail, 9 in.; hind foot, 2 in. Reduced to millimeters (assuming that he used the Rhineland foot) these measurements are as follows: Total length, 733; tail vertebræ, 235; hind foot, 52; which do not differ radically, except in length of body, from measurements of specimens recently taken in Louisiana. The great length of body was undoubtedly due to stretching of the skin.

Valley. The hairy soles ascribed by him to this species have not been observed in any species of the genus.

The Louisiana skunk was later described by Bangs as a subspecies of '*mephitica*' (= *mephitis* and *putida*). With *mephitis* it apparently has no connection; from *putida* it may be distinguished by its small size, short tail, and narrow skull with square palate. These characters also distinguish it from *elongata*. In most of the specimens examined the tail ends in a blunt black brush, as in *varians* and *hudsonica;* but a few from both extremes of its range have a slender white pencil, shorter than in *putida*. One specimen from Marble Cave, Missouri, is nearly all white above, including the tail. The shape and size of the anterior palatine foramina are variable in this species, some individuals having the large rounded foramina which appear in the subgenus *Leucomitra*.

Specimens examined.—Total number, 39, from the following localities:

Louisiana: Cartville, Acadia Parish, 2; Point aux Loups Springs, 5; Calcasieu Parish, 11; Calcasieu Pass, 1.

Texas: Matagorda Peninsula, 3; Virginia Point, 1; San Antonio, 3; Aransas County, 1; Gainesville, 2; Henrietta, 1; Wichita Falls, 1.

Oklahoma: Fort Cobb, Washita River, 1.

Missouri: Marble Cave, Stone County, 7.

CHINCHA MESOMELAS AVIA (Bangs). ILLINOIS SKUNK.

Mephitis avia Bangs, Proc. Biol. Soc. Wash., XII, p. 32, 1898.

Type locality.—San Jose, Illinois.

Geographic distribution.—Prairie region of Illinois, western Indiana, and eastern Iowa; boundaries of range imperfectly known.

General characters.—Resembles *mesomelas* very closely, but skull slightly larger.

Color.—The series from the type locality is variable; in some the white stripes terminate about the middle of the back, in others they reach to the root of the tail. Tail wholly black, with or without a white pencil.

Cranial characters.—Skull slightly larger than that of *mesomelas;* zygomata more widely expanded; upper carnassial large; palate variable in length, ending sometimes in front of and sometimes behind plane of last molars.

Measurements.—Average of two adult males from type locality:[1] Total length, 641; tail vertebræ, 184; hind foot, 65; one adult female from Freeport, Illinois: 610; 220; 68.[2] *Skull:* (See table, p. 44).

General remarks.—This form is very closely related to *mesomelas* from which it differs chiefly in greater size and perhaps shorter tail.

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[1] *Fide* Bangs.

[2] These measurements, taken in the flesh from a specimen which died in the National Zoological Park, show that the species may have a somewhat longer tail than Bangs's measurements indicate, and not appreciably shorter than that of *mesomelas*.

While its range meets that of *putida* in Indiana intergradation seems not to take place. The differences between *avia* and *putida* have already been pointed out (see p. 27).

Specimens examined.—Total number, 10, from the following localities:

Illinois: San Jose, 6; Freeport, 1; 'Illinois,' 1.
Indiana: Fowler, Benton County, 1.
Iowa: Delaware County, 1.

CHINCHA MESOMELAS VARIANS (Gray). LONG-TAILED TEXAS SKUNK.

Mephitis varians Gray, Charlesworth's Mag. Nat. Hist., I, p. 581, 1837.

Mephitis macroura Aud. & Bach., Quad. N. Am., III, p. 11, 1854 [not *M. macroura* Licht.].

Mephitis mesomelas Allen, Bull. Am. Mus. Nat. Hist., VI, p. 188, 1894 [not *M. mesomelas* Licht.]; Elliot, Synop. Mamm. N. A., Field Columbian Museum, Zool. Ser., II, p. 325, 1901 [not *M. mesomelas* Licht.].

Type locality.—Texas (specimens from lower Rio Grande Valley considered typical).

Geographic distribution.—Southern and western Texas, eastern New Mexico, and adjacent parts of Mexico; north into Oklahoma, Colorado, Kansas, and Nebraska.

General characters.—Size large; *tail very long;* markings similar to those of *hudsonica*, constant; skull longer than that of *mesomelas.*

Color.—Similar to that of *hudsonica;* white stripes narrower than in *estor;* tail ending in a black brush *without* a pencil; white hairs intermixed in the tail, usually showing prominently in upper surface to about the middle of the tail, where they form an indistinct band.

Cranial characters.—Skull of medium size, smaller and narrower than that of *hudsonica;* longer than that of *mesomelas;* zygomata spreading less abruptly, and palate averaging shorter than in *hudsonica;* ascending branches of premaxillæ very long.

Measurements.—Average of 4 adult males from vicinity of Brownsville, Texas: Total length, 758; tail vertebræ, 393; hind foot, 71. Average of 4 adult females from lower Rio Grande Valley (Laredo and vicinity): 681; 376; 69. *Skull:* (See table, p. 44.)

General remarks.—In Gray's original description of this species he remarks that it inhabits Texas, and in a later paper mentions that the tail is as long as the body.[1] Two forms are found in Texas, either of which might be the subject of the original description, but only one of these, the larger, has a tail as long as the body. To this form, therefore, the name is restricted.[2]

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[1] Cat. Carnivora Brit. Mus., p. 136, 1869.

[2] Dr. J. A. Allen has endeavored to fix Lichtenstein's name, *mesomelas*, to this form (Bull. Am. Mus. Nat. Hist., VI, p. 188, 1894), but that this can not be done is evident upon comparing the measurements of this species with those of *mesomelas* as given by Lichtenstein (see footnote p. 29). The specimens on which Dr. Allen based his views came from Oklahoma and belong to the large form—not the small one, of whose presence in Louisiana he was at the time unaware. The body and tail measurements made by him from dry skins, do not correctly represent the average measurements of *varians;* but the size and characters of the skull leave no doubt as to the identity of the specimens.

The species varies greatly in size: thus specimens from the lower Rio Grande Valley have much longer tails and rather smaller skulls than those inhabiting central Texas, Oklahoma, and Colorado. In southeastern Texas, in the vicinity of Matagorda Bay, it intergrades with *mesomelas*, whose range extends westward along the coast from Louisiana. In a series of 7 specimens from O'Connorport (opposite Matagorda Island), which are evidently intermediate, the markings are like those of *varians* while the skulls are small like those of *mesomelas*, and the tails average 312 mm.—much longer than the average tail measurement of *mesomelas*. Seven skins from Mason, Texas, show much more white than typical specimens, in this respect approaching *estor*, from which some of them can be distinguished only by greater size and longer tail. More than half of these Mason skins have the white hairs of the tail extending beyond the tip, and some have a distinct white pencil.

Specimens examined.—Total number, 139, from the following localities:

Tamaulipas: Matamoras, 2; Mier, 1.

Texas: Brownsville, 7; Corpus Christi, 1; Nueces Bay, 2; Santa Tomas, 1; Hidalgo, 2; Rio Grande City, 1; Padre Island, 1; Laredo, 2; Eagle Pass, 3; Mouth of Pecos River, 1; Presidio County, 2; El Paso, 2; East Painted Cave, Valverde County, 1; Indianola, 1; O'Connorport, 7; Rockport, 3; Fort Richardson, Jack County, 1; Berne, 1; Mason 7; Gail, 1; Colorado, 5; Fort Clark, Kinney County, 1; Sherwood, 2; Langtry, 2; Pecos High Bridge (Southern Pacific R. R.), 2; Chisos Mountains, 1; Davis Mountains, 1.

New Mexico: Hall Peak, 2; Eddy, 1.

Oklahoma: Beaver River, Beaver County, 9.

Colorado: Arkins, Larimer County, 20; Chivington, 1; Cañon City, 1; Boulder County, 1; Costilla County, 2; Conrow, 1; Loveland, 1.

Kansas: Cedarvale, 1; Neosho Falls, 1; Trego County, 5; Long Island, 2; Onaga, 3.

Nebraska: Johnstown, 21 (skulls); Valentine, 1; Cherry County, 1; Loup Fork River, 1.

CHINCHA ESTOR (Merriam) ARIZONA SKUNK.

Mephitis estor Merriam, N. Am. Fauna No. 3, p. 81, 1890.

Type locality.—San Francisco Mountain, Arizona.

Geographic distribution.—Arizona, western New Mexico, Sonora, Chihuahua, and northern Lower California; south in the Sierra Madre to southern Chihuahua; limits of range unknown.

General characters.—Size rather small; tail shorter than that of *varians; much white on body and tail;* skull resembling that of *varians*, but smaller.

Color.—White stripes on back very broad—almost confluent; posterior back wholly white in some specimens; tail of black and white hairs, the white longer and chiefly on the upper surface, where they extend beyond and nearly conceal the black; white pencil at tip. (See Pl. II, fig. 3.)

Cranial characters.—Skull resembling that of *varians* in general shape but *smaller and slenderer;* palate ending about on a line with posterior molars, either square or with a very small notch; molars smaller than in either *varians* or *occidentalis;* anterior palatine foramina small and narrow. (See Pl. VII, figs. 3 and 4.)

Measurements.—Average of 7 adult males from Arizona and adjacent parts of Mexico: Total length, 639; tail vertebræ, 285; hind foot, 69. Average of 4 adult females from same localities: 580; 273; 63. *Skull:* (See table, p. 44.)

General remarks.—The Arizona skunk is a very distinct species inhabiting Arizona, New Mexico, and adjacent parts of Mexico. In southern Arizona and Chihuahua its range overlaps that of *milleri*, the two species being often found at the same place. By reason of this fact, and on account of the extreme variability of *milleri*, the two have been frequently confused by authors, and many references to *estor* really apply to *milleri*. There need be no difficulty, however, in distinguishing them, either by skin or skull. The hooded skunks (to which group *milleri* belongs), while extremely variable, are usually either wholly black or wholly white on the back, and never have the two white stripes of *Chincha;* the tail is longer than the head and body (about 52 per cent of the total length). *Estor* is rather constant in markings, and has the white stripes of the other United States species inclosing a small patch of black, while the tail is shorter than the head and body (about 44 per cent of the total length). In the few cases in which *estor* has the whole back white, the purity of the white will serve to distinguish it from *milleri*, in which the white is of a grayish hue, due to the intermixture of black hairs. The very pronounced skull characters distinguishing the two groups are pointed out under the description of the subgenus *Leucomitra* (p. 39).

Estor differs from both *varians* and *occidentalis* in smaller size and shorter tail, and in the much greater extent of white on its body and tail. Specimens from the Mexican boundary line at the west base of the San Luis Mountains are somewhat larger than the typical form of *estor*, and one of them is plainly referable to *varians*, so it is possible that intergradation takes place between the two.

Specimens examined.—Total number, 55, from the following localities:

Arizona: San Francisco Mountain, 3; Springerville, 3; Holbrook, 1; Calabasas, 2; Yuma, 1; Fort Mohave, 1; Fort Verde, 12; Fort Huachuca, 1; Huachuca Mountains, 2; Huachuca Station, 1; Prescott, 1; Pinal County, 4; Whipple Barracks, 1.

New Mexico: Fort Wingate, 1; Cloverdale, Grant County, 1; Hachita, 1.

Sonora (near Mexican boundary line): Santa Cruz River, 1; San Pedro River, 1; Patagonia Mountains, 2; west side San Luis Mountains, 1; San Luis Springs, 1; Animas Valley, 1; San Bernardino Ranch (monument 77, Mexican boundary line), 1; La Noria (monument 111, Mexican boundary line), 1.

Chihuahua: White Water, 1; Cajon Bonita Creek (near Mexican boundary), 1; Colonia Garcia, 6; Sierra Madre (near Guadalupe y Calvo), 1.

Lower California: Poso Vicente, 1.

CHINCHA OCCIDENTALIS (Baird). CALIFORNIA SKUNK.

Mephitis occidentalis Baird, Mamm. N. A., p. 194, 1857.

Type locality.—Petaluma, California.

Geographic distribution.—Northern and central California, from vicinity of Monterey Bay northward, west of the Sierra and Cascades, to the Willamette Valley, Oregon.

General characters.—Size rather large; resembling *hudsonica* quite closely, but *tail longer; skull relatively narrow across zygomata;* palate rather long, sometimes with a distinct median notch.

Color.—Closely resembling *hudsonica* in pattern of coloration; white stripes of medium width, and frequently extending down sides of tail, though the white hairs never reach beyond the tip. The markings show little variation.

Cranial characters.—Compared with that of *hudsonica*, the skull of *occidentalis* is much *narrower across the zygomata, which spread less abruptly* and are more nearly parallel to the axis of the skull. Palate rather long, usually with a distinct median notch, though this is not always present, even in the typical form. The largest skulls of *occidentalis* equal those of *hudsonica* in length and in mastoid breadth, but the majority are somewhat shorter and narrower. (See Pl. VII, figs. 1 and 2.)

Measurements.—Type:[1] Total length, 800; tail vertebræ, 312; hind foot, 77. Average of 5 adult males from vicinity of San Francisco Bay: 693; 303; 78. One adult female from Auburn, California: 700; 330; 75. *Skull:* (See table, p. 44.)

General remarks.—The California skunk was recognized as distinct by Baird in 1857. With its four subspecies it forms a well-marked group, quite distinct from any of the eastern members of the genus, and has an extensive range. It equals *hudsonica* in size, but has a longer tail, and differs materially in cranial characters. The colors are very constant, but the skulls show great individual variation. The length of the tail is also variable, ranging from 265 to 370 mm. A series of skulls from Cassel, Shasta County, California, average larger than the typical form, and two specimens in the series are clearly intermediate between *occidentalis* and *major*. A specimen from Lake Tahoe likewise shows characters intermediate between these two forms. On the north intergradation with *spissigrada* is shown by a large series from Lake Cushman, Washington; while to the southward the typical form merges gradually into *holzneri*. Its relationships with *notata* and *platyrhina* are not clear, but intergradation with these is probable.

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[1] *Fide* Baird.

Specimens examined.—Total number, 107, from the following localities:

California: Petaluma, 1; Glen Ellen, 1; Novato, 1; Nicasio, 5; Point Reyes, 2; Mt. Tamalpais, 1; Fairfield, 2; Walnut Creek, 1; Santa Clara, 1; Salt Springs, Fresno River, 1; Wawona, 12 (skulls); Pine City, 7 (skulls); Yosemite Valley, 4; Mariposa County, 6 (skulls); South Fork Merced River, 1; Carbondale, 1; Hope Valley, Alpine County, 2; Markleeville, 1; Lake Tahoe, 2; Blue Canyon, 1; Auburn, 2; Tehama, 1; Red Bluff, 2; Sherwoods, 1; Cahto, 1; Cassel, Shasta County, 29 (skulls); Baird, Shasta County, 1; Shasta Valley, 2; Sisson, 2; Pitt River, Shasta County, 4; Fort Crook, Shasta County, 1; Big Valley Mountains, Lassen County, 1.

Oregon: Roseburg, 1; Eugene, 1; Grant Pass, Rogue River Valley, 5.

CHINCHA OCCIDENTALIS SPISSIGRADA (Bangs). PUGET SOUND SKUNK.

Mephitis spissigrada Bangs, Proc. Biol. Soc. Wash., XII, p. 31, 1898.

Mephitis fœtulenta Elliot, Field Columbian Museum, pub. 32, Zool. Ser., I, no. 13, p. 269, 1899.

Type locality.—Sumas, British Columbia.

Geographic distribution.—Shores of Puget Sound and coast region of Washington and northern Oregon.

General characters.—Resembling *occidentalis*, but with *shorter tail*, and more white on body and tail; *palate short*, without notch.

Color.—As in *occidentalis*, but body stripes very broad, and much white in tail. The white stripes bifurcate about the middle of the back (instead of between the shoulders as in *occidentalis*) and extend down the sides of the tail, the long white hairs frequently reaching beyond the tip. In most of the specimens examined the body stripes have a distinctly yellowish cast, but this is not a constant character. (See Pl. III, fig. 3.)

Cranial characters.—Skull similar to that of *occidentalis*, but *shorter, and relatively broader across zygomata;* rostrum averaging broader; bullæ slightly larger; *palate ending squarely*, with no trace of a notch, *even with last molars;* lower carnassial smaller; nasals long; ascending branches of premaxillæ very long and narrow.

Measurements.—Average of 3 adult males from type locality: Total length, 653; tail vertebræ, 246; hind foot, 79. Average of 2 adult females from type locality: 625; 235; 75. Average of 3 adult males from Neah Bay, Washington: 630; 230; 84. *Skull:* (See table, p. 44.)

General remarks.—This is a handsome skunk and is said to be very abundant, feeding in large numbers on the ocean beaches. It occupies a comparatively small area and is a strongly marked subspecies. Its short tail and the great amount of white in the markings distinguish it from typical *occidentalis*. From *hudsonica*, it differs chiefly in its shorter palate, weaker and less abruptly spreading zygomata, and less mastoid breadth. Skulls of females of *spissigrada* and *hudsonica* bear a close resemblance to one another; those of the young may be distinguished by the longer nasals of *spissigrada*.

Since the original description of this form, additional material from the type locality shows clearly its relationship to *occidentalis* and establishes its identity with *fœtulenta* of Elliot. Specimens from the shores of the Olympic peninsula, on which *fœtulenta* was based, show the greatest extreme in the characters assigned, but the differences between them and specimens from Sumas are too slight to warrant even subspecific recognition. The slight notch in the palate exhibited by Elliot's specimens is due to the fact that they are all immature. In the comparisons on which the present results are based, a series of adult specimens from Neah Bay has been used. Specimens from Washington south of the Olympics are intermediate in characters between *spissigrada* and *occidentalis*, as is shown by the longer tail, longer skull, and notched palate.

Specimens examined.—Total number, 52, from the following localities:

British Columbia: Sumas, 6.
Washington: Neah Bay, 5; The Lagune, near Port Angeles, 3; Lapush, 1; Port Townsend, 1; Steilacoom, 5; Tenino, 2; Lake Cushman, 26 (skulls); Chehalis County, 2.
Oregon: McCoy, 1.

CHINCHA OCCIDENTALIS NOTATA subsp. nov. CASCADE SKUNK.

Type from Trout Lake, Mount Adams, Washington, ♂ adult, No. 87043, U. S. Nat. Mus., Biological Survey, Coll. Collected March 22, 1897, by Peter Schmid.

Geographic distribution.—Southern Washington and northern Oregon, east of the Cascades; exact limits of range unknown.

General characters.—Similar to *occidentalis*, but tail shorter; skull slightly larger and dentition heavier; *body stripes very narrow, and separated for their entire length.*

Color.—Similar to that of *occidentalis*, but body stripes much narrower (about 15 mm. broad in average specimens) and sometimes interrupted; usually, but not always, joined at nape, and not confluent anywhere else. Tail usually all black exteriorly, but sometimes with a little white on each side near the base. In the type and some other specimens, the body stripes terminate about the middle of the back. (See Pl. III, fig. 2.)

Cranial characters.—Skull slightly larger than that of *occidentalis;* palate ending nearly squarely, with no distinct notch; nasals short; *upper molars large*, often exceeding those of the largest specimens of *major; lower carnassial broad.*

Measurements.—Average of 3 adult males from type locality: Total length, 633; tail vertebræ, 249; hind foot, 76. Average of 5 adult females from The Dalles, Oregon: 659; 286; 69. *Skull:* (See table, p. 44.)

General remarks.—This form shows greater variability in markings than any other of the western skunks and is the only one in which the body stripes are ever interrupted. In skull characters it resembles *occidentalis* quite closely, but lacks the notch in the palate and has much larger molars. It probably intergrades with both *occidentalis* and *major.*

Specimens examined.—Total number, 41, from the following localities:

Washington: Trout Lake, Mount Adams, 31 (skins with skulls, 6; skulls only, 25); Rockland, Klickitat County, 1; Goldendale, 1.
Oregon: The Dalles, 8.

CHINCHA OCCIDENTALIS MAJOR subsp. nov. GREAT BASIN SKUNK.

Type from Fort Klamath, Oregon. ♂ adult, No. 92238, U. S. Nat. Mus., Biological Survey Coll. Collected Jan. 5, 1898, by B. L. Cunningham. Original number, 80.

Geographic distribution.—Eastern Oregon, northern California, and Nevada; east to the Wasatch Mountains in Utah.

General characters.—Similar to *occidentalis* but much larger; *hind foot longer; skull larger* and more heavily built.

Color.—Much as in *occidentalis:* white stripes broad, bifurcating near the middle of the back, and extending only a short distance on the tail, which is nearly all black exteriorly.

Cranial characters.—*Skull larger* and more heavily built than that of *occidentalis; rostrum broader and much flattened; braincase broader and not so deep*, thus giving a flattened appearance to the upper surface of the skull; dentition heavier; palate long, usually ending in a concave line, sometimes irregularly notched; ascending branches of premaxillæ short and broad.

Measurements.—Average of 5 adult males from type locality: Total length, 705; tail vertebræ, 306; hind foot, 84. *Skull:* (See table, p. 44.)

General remarks.—This subspecies seems to be the largest and heaviest skunk in the genus; the hind foot is both longer and broader than in any other member of the genus, and the front foot is correspondingly large. The large skull with its broad braincase readily distinguishes the form from its congeners. In the series from the type locality, the characters are constant, but the subspecies undoubtedly intergrades with *occidentalis* in northern California, and possibly with *notata* in northern Oregon. Specimens from western Nevada are provisionally included with *major*, although by reason of the fact that no males have been examined—female skunks are less readily separable—their exact relationships are uncertain. Specimens from Ogden, Utah, are clearly referable to this form. Immature skulls of *major* may be distinguished from those of both *occidentalis* and *hudsonica* by the broad premaxillæ.

Specimens examined.—Total number, 27, from the following localities:

Oregon: Fort Klamath, 6; Tule Lake, 2; Plush, Lake County, 1; Shirk, Harney County, 4; Harney, 2; Elgin, 1.
Washington: Touchet, 1.
California: Lassen Creek, Shasta County, 1; Honey Lake, 1; Sierra Valley, 1.
Nevada: Carson, 1; Reno, 1; Quinn River Crossing, Humboldt County, 1.
Utah: Ogden, 6; Provo, 1.

CHINCHA OCCIDENTALIS HOLZNERI (Mearns). SOUTHERN CALIFORNIA SKUNK.

Mephitis occidentalis holzneri Mearns, Proc. U. S. Nat. Mus., XX, p. 461, 1897.

Type locality.—San Isidro Ranch, Lower California.

Geographic distribution.—Southern California, from vicinity of Monterey Bay south into Lower California; east to the Sierra Nevada and San Bernardino Range; limits of southward range unknown.

General characters.—Similar to *occidentalis* but smaller.

Color.—There are no appreciable color differences to distinguish this form from *occidentalis*. (See Pl. III, fig. 1.)

Cranial characters.—*Skull smaller* than that of *occidentalis* and *relatively narrow in mastoid region;* audital bullæ more circumscribed, but rather prominent; palatal notch usually absent.

Measurements.—Type (adult male):[1] Total length, 665; tail vertebræ, 273; hind foot, 72. Average of 3 adult males from Twin Oaks, San Diego County: 637; 292; 71. Average of 3 females (barely adult) from San Diego County: 605; 291; 64. *Skull:* (See table, p. 44.)

General remarks.—This form does not differ greatly from *occidentalis*, but averages considerably smaller in cranial measurements. The body and tail measurements of *holzneri* are slightly smaller than those of *occidentalis*, and the hind foot is decidedly shorter. Specimens from Ventura and adjacent counties are intermediate between the two forms, having the long tail of *occidentalis*, but very small skulls.

Specimens examined.—Total number, 41, from the following localities:

Lower California: San Isidro Ranch, 3.
California: Dulzura, 3; Twin Oaks, 5; Witch Creek, 2; Unlucky Lake, San Diego County, 1; Pacific coast at Mexican boundary, 1; Santa Ysabel, San Diego County, 1; Santa Paula, 2; San Fernando, 1; Ventura River, 1; Santa Ynez Mission, 3; Gaviota Pass, Santa Barbara County, 2; San Emigdio, Kern County, 1; Morro, 1; San Luis Obispo, 3; San Simeon, 2; Monterey, 3; South Fork Kern River (25 miles east of Kernville), 1; Three Rivers, 5.

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[1] *Fide* Mearns.

CHINCHA PLATYRHINA sp. nov. BROAD-NOSED SKUNK.

Type from South Fork of Kern River (25 miles east of Kernville), California, ♂ adult, No. $\frac{29284}{41331}$, U. S. Nat. Mus., Biological Survey Coll. Collected July 5, 1891, by Vernon Bailey. Original number, 2998.

Geographic distribution.—Known only from the type locality and from Owens Valley.

General characters.—Externally much like *occidentalis;* skull with peculiarly shaped zygomata and *very broad rostrum.*

Color.—Resembling *occidentalis:* white stripes of medium width, produced only a short distance on the sides of the tail; tail black externally, except for an indistinct band of white on the upper surface about $\frac{2}{3}$ the distance from base to tip. Specimens from Owens Valley have most of the tail hairs *chestnut* instead of black, exteriorly; and in one case most of the body is chestnut. This is probably due to fading.

Cranial characters.—Skull resembling that of *occidentalis*, but shorter and relatively broader; much flattened in frontal region; *rostrum very broad*—actually and relatively broader than in largest specimens of *occidentalis;* zygomata spreading less abruptly and in an even curve nearly parallel to the axis of the skull; palate nearly square, with only a very slight notch; audital bullæ small, and slightly inflated; tube of auditory meatus short; nasals short and broad.

Measurements.—Type (adult male): Total length, 750; tail vertebræ, 320; hind foot, 90. Average of 3 adult females from Owens Valley: 679; 332; 79. *Skull:* (See table, p. 44).

General remarks.—This species shows no marked characters of pelage to distinguish it from *occidentalis*, which it equals or exceeds in size, but its peculiar skull at once serves to separate it. As typical *holzneri* occurs at the type locality of *platyrhina*, it is evident that intergradation does not take place between the two species at this point. It is quite likely, however, that *platyrhina* intergrades with *major;* but until there is material available to show such intergradation, a binomial designation seems preferable. The skull resembles that of *major* in general shape, but is very much smaller, and relatively broader across the postorbital processes.

Specimens examined.—Total number, 9, from the following localities:

California: South Fork Kern River, 5; Owens Valley, 2; Owens Lake, 2.

Subgenus LEUCOMITRA.

LEUCOMITRA, *subgen. nov.* HOODED SKUNKS.

Type.—*Chincha macroura* (Lichtenstein). From mountains northwest of the City of Mexico.

Subgeneric characters.—Skull (Pl. VIII) short and broad; interpterygoid fossa narrowly U-shaped; palate without notch or spine;

anterior palatine foramina large and rounded; audital bullæ large and greatly inflated; tube of auditory meatus short; periotic region slightly inflated; mastoid processes and sagittal crest never greatly developed; zygomata never spreading abruptly, and often nearly parallel to the axis of the skull; interorbital constriction not marked; paroccipital processes directed outward and not sharply pointed; posterior margin of coronoid distinctly concave. Size medium to small; build much slenderer than that of *Chincha;* feet slender; tail very long; ears prominent; fur long and silky but not dense; hairs on the nape elongated and spreading sidewise, forming a sort of hood.

In addition to the characters given above, the hooded skunks differ radically from the large striped skunks (subgenus *Chincha*) in the pattern of coloration (see Pl. IV), and although they exhibit great individual variation, one description will answer for the three forms comprised in the subgenus.

Two patterns occur, one in which the upperparts are chiefly white, the underparts black; the other in which the upperparts are nearly all black, with narrow lateral stripes, and under surface of tail white. Between these two extremes are many intermediate phases. The frontal stripe is narrow and often absent.

In the *white-backed* phase a broad band of white begins between the ears and covers the whole back and upper surface of the tail, the long white hairs drooping gracefully from the sides and over the tip of the tail. This band is of varying width, but is never bifurcated as in true *Chincha*. There may or may not be a white lateral line separated from the dorsal band by a black area. The dorsal band is never of the deep creamy hue so frequent in the stripes of *Chincha*, but is composed of nearly pure white hairs with numerous black ones intermixed, and so is more or less distinctly grayish in effect. The lateral stripes, when present, are always without this mixture of black hairs.

The *black-backed* phase usually has the narrow frontal stripe, and may have the white hood, which, however, is often absent. The white lateral stripe is almost always present, though varying in width from an inch or more to a mere trace; it is frequently replaced by two narrow stripes on each side. The lower surface of the tail is usually white, though sometimes the whole tail is black externally.

As in the typical subgenus, the bases of the tail hairs in both phases are invariably white. Irregular white spots on the ventral surface of the body are frequent.

In some of its characters, this subgenus shows an approach toward the genus *Mephitis* (*Spilogale* of authors), particularly in the shape of the audital bullæ and the anterior palatine foramina. In the concave border of the coronoid it resembles the white-backed skunks (*Thiosmus*); but this is a character that sometimes appears in true *Chincha*. The parasites found occasionally in the skulls of all skunks are especially frequent in this subgenus.

Descriptions of Species and Subspecies.

CHINCHA MACROURA (Lichtenstein). HOODED SKUNK.

Mephitis macroura Lichtenstein, Darst. Säugeth., pl. 46, with accompanying text, 1832.—Baird, Mamm. N. Am., 1857, p. 200. [Not *M. macroura* Aud. and Bach.]
Mephitis mexicana Gray, Charlesworth's Mag. Nat. Hist., I, p. 581, 1837.
Mephitis longicaudata Tomes, Proc. Zool. Soc. London, 1861, p. 280.

Type locality.—Mountains northwest of the city of Mexico.

Geographic distribution.—Highlands of central and southern Mexico; south to Guatemala.

General characters.—*Size medium;* coloration as in other members of the subgenus—extremely variable; skull with sagittal crest and mastoid processes well developed.

Color.—The description of the color given in the remarks on the subgenus will apply to this species, with the added note that quite a large proportion of the specimens examined are in the black phase, and that the white pencil is frequently absent. (See Pl. IV, fig. 1.)

Cranial characters.—*Skull of medium size* (for the subgenus); sagittal crest and mastoid processes (in adult males) well developed; molars small; anterior palatine foramina large and rounded; posterior margin of palate an even curve, ending on a line with last molars.

Measurements.—Average of 4 adult males from near the type locality (Querendaro, Nahuatzin, and Salazar): Total length, 623; tail vertebræ, 299; hind foot, 67. Average of 4 adult females from same localities: 594; 297; 60.5. *Skull:* (See table, p. 44).

General remarks.—This species was described by Lichtenstein in 1832, and his name has been very generally adopted by subsequent authors. His type came from the mountains northwest of the city of Mexico, and specimens from Salazar are considered typical. The Guatemala form has been described by Tomes under the name *longicaudata*, but specimens from the vicinity of Dueñas show that it is not separable from the typical form. The southern limit of range is unknown, but it will probably be found little south of the highlands of Guatemala. To the northward *macroura* grades imperceptibly into *milleri*.

Specimens examined.—Total number, 60, from the following localities:

Mexico: Tlalpam, 4; Amecameca, 1; Salazar, 2.
Hidalgo: Marques, 1; El Chico, 1; Irolo, 1; Encarnacion, 1; Zimapan, 1; Real del Monte, 1.
Michoacan: Querendaro, 4; Patzcuaro, 1; Nahuatzin, 2.
Colima: Colima, 4; Hacienda Magdalena, 1.
Jalisco: Ameca, 2; San Sebastian, 1.
Tepic: Santa Teresa, 1.
Zacatecas: Valparaiso, 1.
San Luis Potosi: Hacienda La Parada, 6.
Tamaulipas: Jaumave, 1.
Morelos: Cuernavaca, 5.

Puebla: Chalchicomula, 1; Tehuacan, 1; Piaxtla, 2.
Vera Cruz: Perote, 1; Las Vigas, 2; Jico, 4; Orizaba, 1.
Oaxaca: Oaxaca (mountains 15 miles west), 1.
Guatemala: Dueñas (vicinity), 5.

CHINCHA MACROURA MILLERI (Mearns). NORTHERN HOODED SKUNK.

Mephitis milleri Mearns, Proc. U. S. Nat. Mus., XX, p. 467, 1897.

Type locality.—Fort Lowell (near Tucson), Arizona.

Geographic distribution.—Southern Arizona, Sonora, and parts of Chihuahua, Sinaloa, Durango, and Coahuila.

General characters.—Very similar to *macroura* but averaging *larger, with heavier skull.*

Color.—Much as in *macroura*, with probably a larger proportion of the white-backed phase. In a series of 15 from Camoa, Sonora, 6 have black backs and 9 white backs. Two of the black-backed ones are with and 4 without the white hood; 1 is wholly black save for a trace of the side stripe and a very narrow frontal stripe. (See Pl. IV, figs. 2, 3, and 4.)

Cranial characters.—*Skull averaging larger* than that of *macroura*, the greatest difference being in the length. Lower carnassial considerably larger, both in length and breadth. (See Pl. VIII, figs. 1 and 2.)

Measurements.—*Type* (an abnormally large specimen): Total length, 790; tail vertebræ, 435; hind foot, 73. Average of 7 adult males from Arizona and adjacent parts of Mexico: 672; 359; 65. Average of 7 adult females from same localities: 668; 357; 61. *Skull:* (See table, p. 44.)

General remarks.—The northern hooded skunk is a rather poorly marked subspecies of *macroura*, the two forms intergrading in central Mexico. The type is a greatly overgrown specimen, as is shown by comparison with a series of adults from near the type locality. Average specimens are somewhat larger than *macroura*, the tail usually exceeding 350 mm. in length and the skulls averaging larger, though it is possible to select specimens from both extremes of their combined range that are almost identical in cranial characters.

The most northern point at which the subspecies has been taken is Fort Grant, Graham County, Arizona, whence it spreads southward over northwestern Mexico, passing into the typical form in the central states of Mexico. Apparently it does not occupy northeastern Mexico, since it has not been recorded from the Rio Grande Valley or from the northern parts of Coahuila, Nuevo Leon, or Tamaulipas.

Specimens examined.—Total number, 55, from the following localities:

Arizona: Fort Lowell, 1; Nogales, 1; Fort Huachuca, 7; Fort Grant, Graham County, 2; Tucson, 1; Calabasas, 1; Fairbank, 2; Santa Catalina Mountains, Pinal County, 5.

Sonora: Patagonia Mountains, 1; Santa Cruz River, 3; Santa Cruz, 1; Hermosillo, 1; Magdalena, 1; Camoa, 15; Alamos, 1.

Chihuahua: Chihuahua, 3; Casas Grandes, 2; Guadalupe y Calvo (mountains near), 3.

Sinaloa: Sierra de Choix, 1.

Coahuila: Jimulco, 2; La Ventura, 1.

CHINCHA MACROURA VITTATA (Lichtenstein). LEAST HOODED SKUNK.

Mephitis vittata Lichtenstein, Darst. Säugeth., pl. 47, with accompanying text, 1832.
Mephitis concolor Gray (Verreaux MS.?), Proc. Zool. Soc. London, 1865, p. 149.
Mephitis vittata var. *b. intermedia* Gray, Cat. Carnivora Brit. Mus., p. 138, 1869.
Mephitis vittata var *c. concolor* Gray, Cat. Carnivora Brit. Mus., p. 138, 1869.

Type locality.—'San Matteo el Mar,' Oaxaca, Mexico.

Geographic distribution.—Known only from the type locality; probably ranges over the coast region of Oaxaca and Chiapas.

General characters.—*Smaller than macroura,* with very small skull, and slightly developed mastoids and sagittal crest.

Color.—As in *macroura;* pencil not distinct. In the series of 18 topotypes examined, 5 are in the black phase.

Cranial characters.—*Skull decidedly smaller* than that of *macroura;* relatively narrow across zygomata, and *mastoids much reduced;* sagittal crest very slightly developed; *bullæ disproportionately large.* (See Pl. VIII, figs. 3 and 4.)

Measurements.—Average of 6 adult males from the type locality: Total length, 558; tail vertebræ, 275; hind foot, 60.4. Average of 12 adult females from the type locality: 585; 300; 59.5. *Skull:* (See table, p. 44.)

General remarks.—This form was described by Lichtenstein at the same time as *macroura*, and his description was accompanied by a good figure of a specimen in the black phase. The description is too meager in details, in the absence of material from the type locality, to clearly establish the validity of the subspecies, but all uncertainty has been removed by the fine series of specimens collected at San Mateo del Mar in 1895 by E. W. Nelson and E. A. Goldman. The form is well marked, differing more from *macroura* than does *milleri*. It is the smallest of the genus, and may be recognized by this fact as well as by its peculiar skull characters. The pelage is rather thin and coarse. The tail is relatively longer than that of *macroura*. Although, as usual, the males have the greater average skull measurements, yet in total length the average of the females is greater. A very large proportion of the skulls examined had been infested with parasites, and the distortion of the cranium through this cause is greater than in any other species examined. One specimen in particular has the swelling produced fully 7 mm. above the normal top of the cranium and spread to a width of 28 mm., although the mastoid breadth of the same specimen is but 31 mm.

Specimens examined. Eighteen, all from the type locality.

Average cranial measurements of Chincha.

Species.	Sex.	Localities.	Basal length.	Basilar length of Hensel.[1]	Greatest zygomatic breadth.	Greatest mastoid breadth.	Breadth across post-orbital processes.	Least interorbital breadth.	Palatal length.	Post-palatal length.	Foramen magnum to plane of last molars.	Number of specimens averaged.
Chincha mephitis	♂	Lake Edward, Quebec	71.5	70	52	44	25.5	23	29.5	40.5	43	1
	♀	....do	65	62.5	47	40.5	24	20.5	27	35.5	38.5	1
C. hudsonica	♂	Saskatchewan, Montana, Wyoming, and Nebraska	75.5	73.8	54.4	45	24.3	19	31	42.8	44.1	4
	♂	Sicamous and Shuswap, British Columbia	72.1	70.1	52.6	43.4	23.5	19.4	29.6	40.5	42.1	4
	♀	....do	66.6	65	46.9	39.1	22.3	18.8	27.8	37.3	38.4	4
C. putida	♂	Westchester and Orange counties, New York	63.5	61.6	45.6	38.8	20.5	17.9	26.3	35.3	36.7	5
	♂	Adirondack Mountains, New York	66	63.6	47.7	40.8	21.5	19.2	26.3	37.3	38.5	5
	♀	Westchester County, New York	58.6	56.7	43.1	36.7	20.8	18	24	32.7	33.5	5
C. elongata	♂	Florida (peninsula)	65	62.9	47.4	38.9	22.3	20.3	27.2	35.7	37.1	5
	♀	....do	60.8	58.9	44.6	37	21.5	19.7	25	33.9	35.1	5
C. mesomelas	♂	Louisiana	60.5	58.5	42.5	34.5	20.9	18.8	24.8	33.6	34.1	6
	♀	....do	57.8	56	41.1	34.1	20.2	17.6	24.2	31.8	32.9	5
C. m. avia	♂	San Jose, Illinois	64.1	62.4	44.7	36.6	21.1	17.4	26.6	36	36	4
	♀	....do	60.8	59	42	35.8	19.5	17.5	24.5	34.5	34.8	2
C. m. varians	♂	Southern Texas and Tamaulipas	64.6	62.5	45.2	37.5	22	19.1	26.6	36	37	7
	♀	Southern Texas	62.8	60.5	44.2	36.4	21.3	19.2	26	34.5	35.8	5
C. estor	♂	Arizona	62.2	60.2	44.3	36.2	20.7	18.2	25.3	34.8	35	3
	♀	Arizona and New Mexico	59.3	57.3	41.2	34.3	20.7	18.5	24.2	33.2	33	3
C. occidentalis	♂	Vicinity of San Francisco Bay, California	72.3	70	49.8	42.4	23.8	20.1	28.8	41.2	42.6	5
	♀	Nicasio and Monterey, California	65.3	62.7	44.7	37.8	21.3	18.5	27.7	35.3	36.8	3
C. o. spissigrada	♂	Sumas, British Columbia	68.8	66.8	50	41.5	23.5	18.9	28	38.8	39.8	2
	♂	Neah Bay, Washington	69.8	68.5	50.4	41	24	20	28	40.5	40.5	4
	♀	Sumas, British Columbia, and Neah Bay, Washington	67.5	66	48	40	22.5	20	27.5	38.5	39.5	

C. o. notata	♂	Trout Lake, Washington	73.1	71.2	52	44.9	23.7	19.7	30.2	41	42.9	7
	♀	.....do	66.1	64.5	45.4	39.4	20.9	18.6	27.8	36.7	37.8	5
C. o. major	♂	Fort Klamath, Oregon	75.3	73.5	52.6	45.8	21.1	20.8	30.5	43	44.6	4
	♀	Plush, Warner Lake, Oregon	67	65	47	41	23	21	27.5	38.5	39	1
C. o. holzneri	♂	Southern California and northern Lower California	66.9	64.5	47.4	38.7	22.2	19.1	27.3	37.2	38.9	7
	♀	Southern California	61.5	59.5	42.5	35.4	19.7	18.3	25.5	34	34.8	5
C. platyrhina	♂	Kern River and Owens Lake, California	69.2	67.7	48.7	40.7	24.7	19.8	29	38.7	40.7	3
	♀	Owens Valley, California	67	65	46.8	39	23.5	19.3	28.5	36.5	38.8	2
C. macroura	♂	Michoacan and Puebla, Mexico	56.3	54.5	42.2	34.4	21.2	(²)	22.9	31.6	31.8	8
	♀	Michoacan and Distrito Federal, Mexico	54.5	53.3	39.2	32.7	19.6	(²)	22.8	30.5	30.5	5
C. m. milleri	♂	Arizona and Sonora	60.3	58.4	43.9	36	22.3	19.4	24.1	34.2	33.8	7
	♀	Arizona	56.4	54.4	39.6	32.6	20.4	18.3	23.5	31	31.3	5
C. m. vittata	♂	San Mateo del Mar, Oaxaca	54.6	52.6	38.3	32.3	20.1	(²)	22	30.6	30.7	5
	♀	.....do	52.3	50.5	38.3	31.8	20.6	(²)	21.2	29.3	29.3	7

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[1] See footnote, p. 21.

[2] On account of the diseased condition of these skulls this measurement could not be taken.

INDEX.

[New names in **black-face type**; synonyms in *italics*.]

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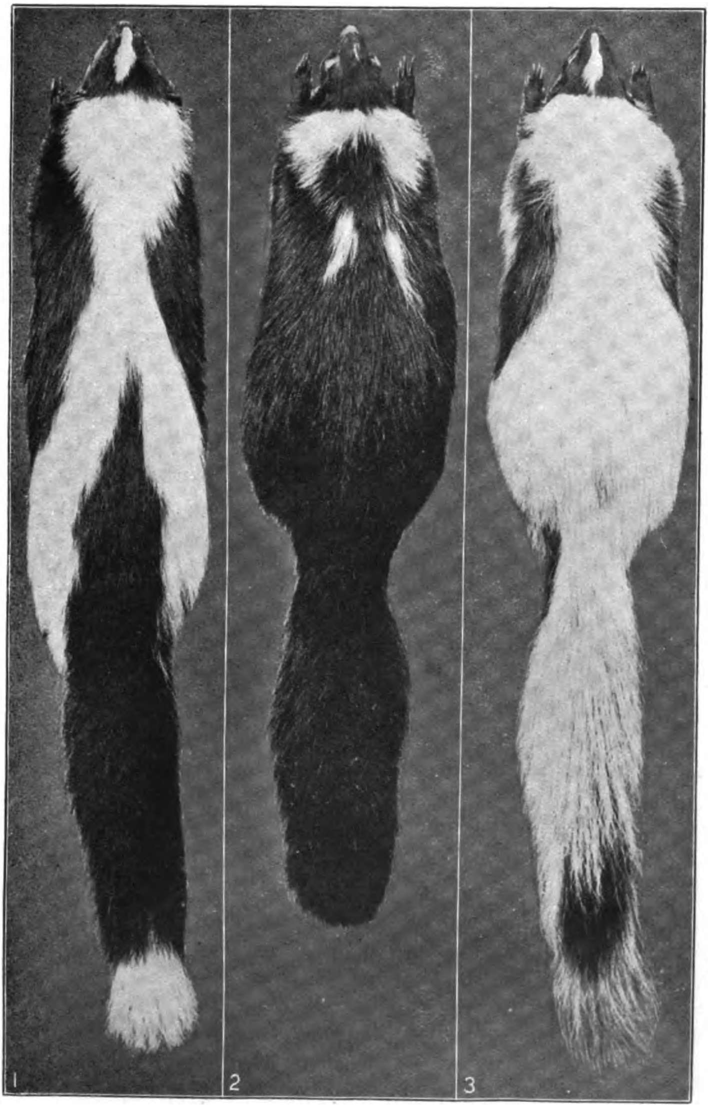
PLATE I.

[Greatly reduced, and relative sizes not accurately shown, owing to differences in preparation of skins.]

FIG. 1. *Chincha putida* (Boitard). Burlington, Massachusetts. (No. 77878, U. S. Nat. Mus.)

2. *Chincha elongata* (Bangs). Fort Kissimmee, Florida. (No. 64017, U. S. Nat. Mus.)

3. *Chincha elongata* (Bangs). Fort Kissimmee, Florida. (No. 64016, U. S. Nat. Mus.)



SKINS OF CHINCHA.

1. *Chincha putida.* 2, 3. *Chincha elongata.*

PLATE II.

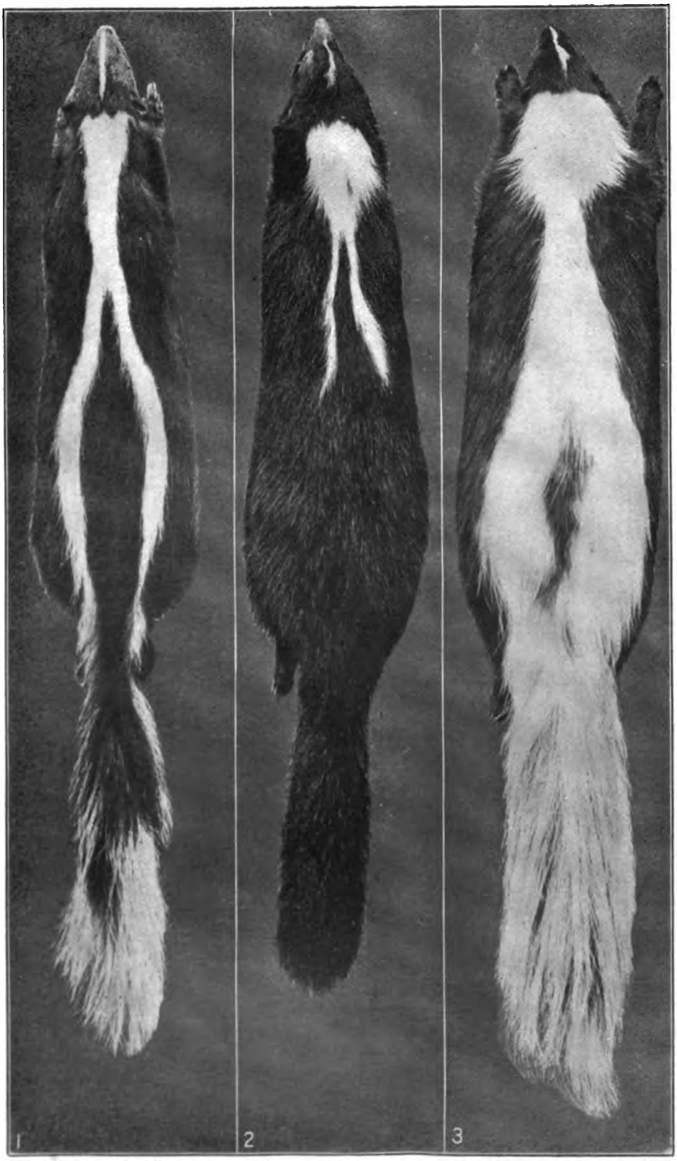
[Greatly reduced, and relative sizes not accurately shown, owing to differences in preparation of skins.]

FIG. 1. *Chincha mephitis* (Schreber). Pine Lake, Keewatin. (No. 107226, U. S. Nat. Mus.)

2. *Chincha mesomelas* (Licht.). Calcasieu Parish, Louisiana. (No. 99831, U. S. Nat. Mus.)

3. *Chincha estor* (Merriam). Holbrook, Arizona. (No. 53209, U. S. Nat. Mus.)

PLATE II.



SKINS OF CHINCHA.

1. *Chincha mephitis.* 2. *Chincha mesomelas.* 3. *Chincha estor.*

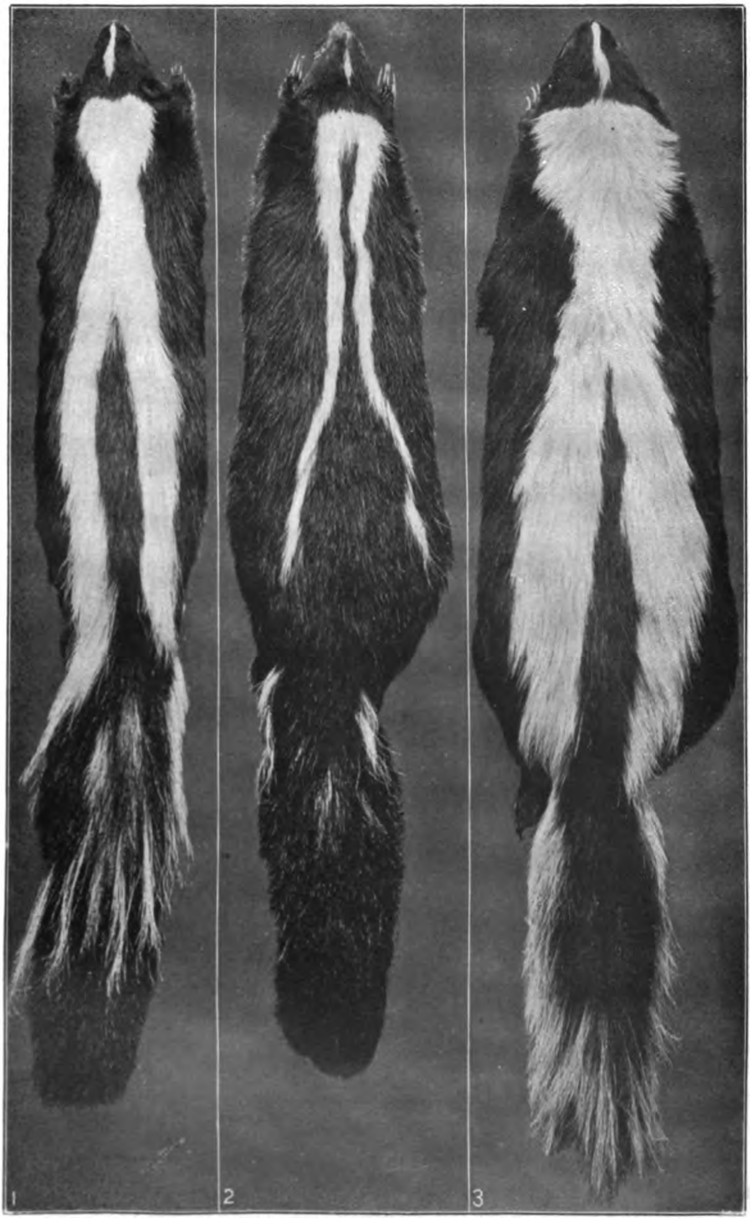
PLATE III.

[Greatly reduced, and relative sizes not accurately shown, owing to differences in preparation of skins.]

FIG. 1. *Chincha occidentalis holzneri* (Mearns). Three Rivers, California. (No. 31244, U. S. Nat. Mus.)

2. *Chincha occidentalis notata* Howell. Trout Lake, Mt. Adams, Washington. (No. 87042, U. S. Nat. Mus.)

3. *Chincha occidentalis spissigrada* (Bangs). Neah Bay, Washington. (No. 88650, U. S. Nat. Mus.)



SKINS OF CHINCHA.

1. *Chincha occidentalis holzneri.* 2. *Chincha occidentalis notata.*
3. *Chincha occidentalis spissigrada.*

PLATE IV.

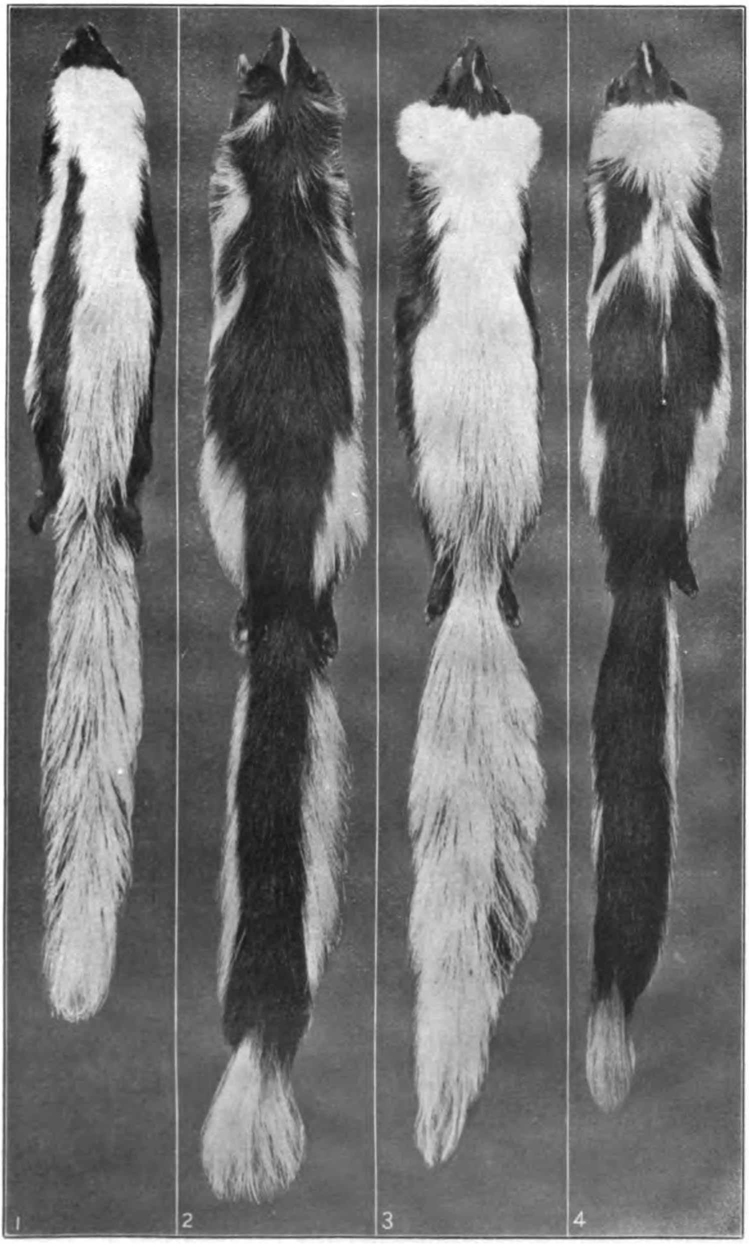
[Greatly reduced, and relative sizes not accurately shown, owing to differences in preparation of skins.]

FIG. 1. *Chincha* (*Leucomitra*) *macroura* (Licht.). Perote, Vera Cruz. (No. 54225, U. S. Nat. Mus.)

2. *Chincha* (*Leucomitra*) *macroura milleri* (Mearns). Camoa, Sonora. (No. 95927, U. S. Nat. Mus.)

3. *Chincha* (*Leucomitra*) *macroura milleri* (Mearns). Camoa, Sonora. (No. 95923, U. S. Nat. Mus.)

4. *Chincha* (*Leucomitra*) *macroura milleri* (Mearns). Camoa, Sonora. (No. 95931, U. S. Nat. Mus.)



SKINS OF CHINCHA (LEUCOMITRA).

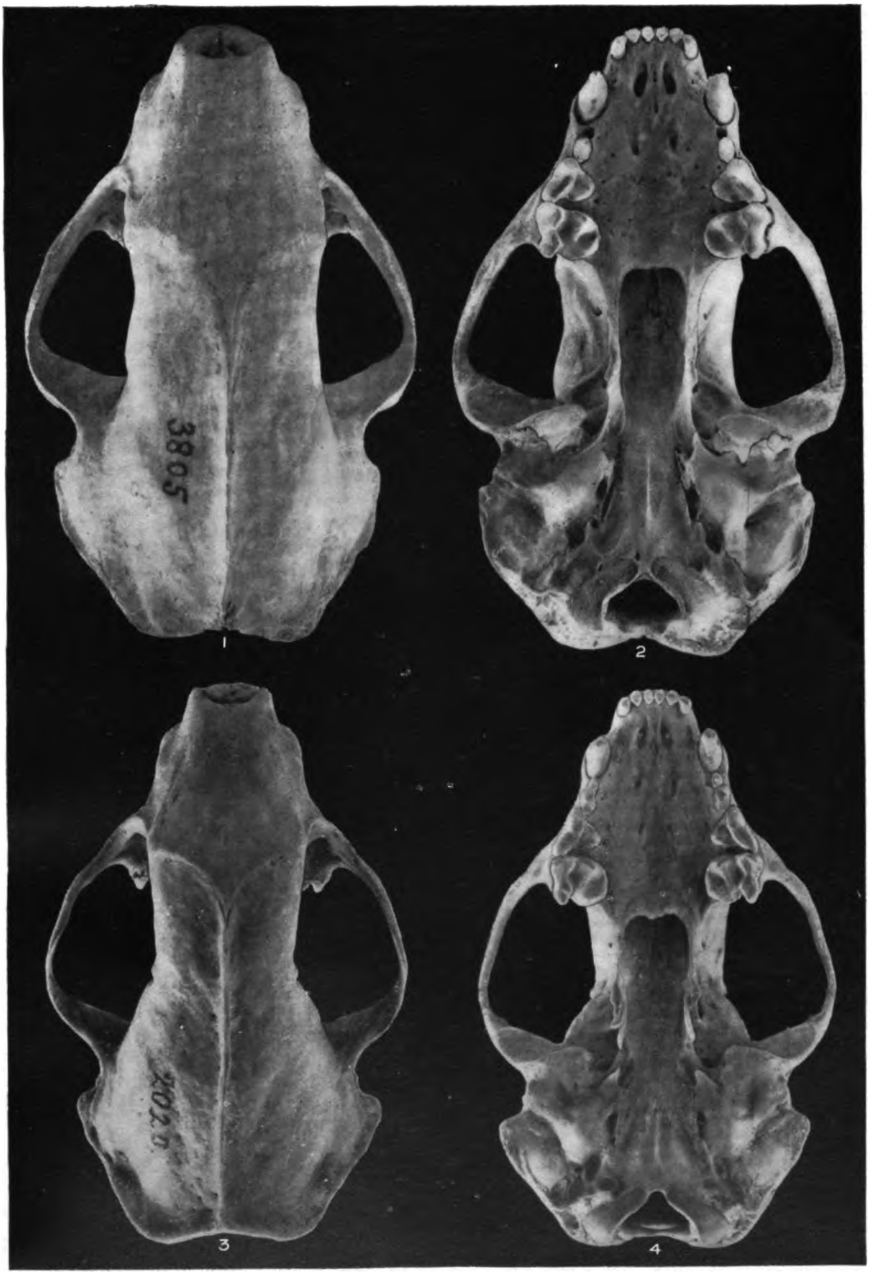
1. *Chincha macroura*. 2, 3, 4. *Chincha macroura milleri*.

PLATE V.

[Natural size.]

FIGS. 1 and 2. *Chincha mephitis* (Schreber). ♂, Lake Edward, Quebec. (No. 3805, Coll. E. A. & O. Bangs.)

3 and 4. *Chincha putida* (Boitard). ♂, Highland Falls, New York. (No. 2020, Am. Mus. Nat. Hist.)



SKULLS OF CHINCHA.

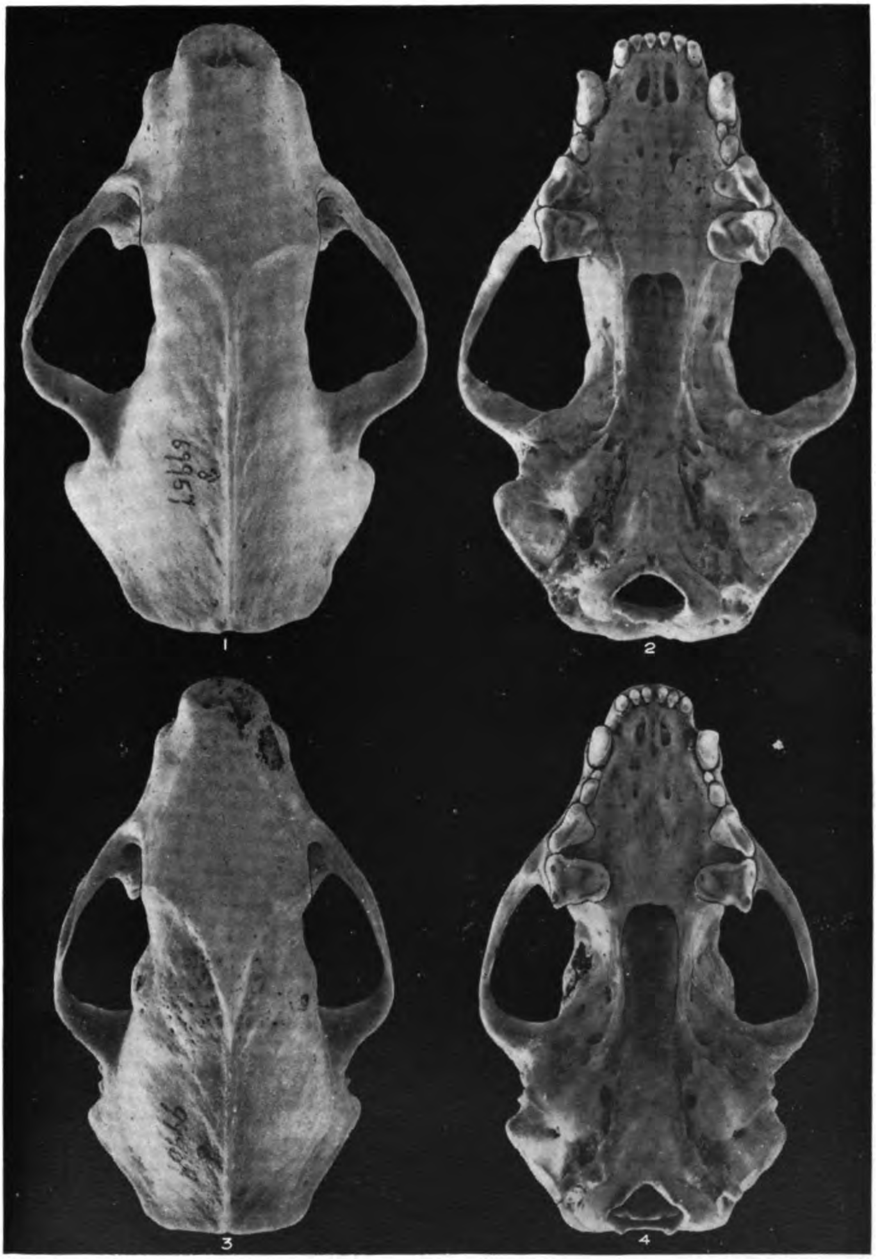
1, 2. *Chincha mephitis*. 3, 4. *Chincha putida*.

PLATE VI.

[Natural size.]

FIGS. 1 and 2. *Chincha hudsonica* (Richardson). ♂, Sicamous, British Columbia. (No. 69957, U. S. Nat. Mus.)

3 and 4. *Chincha mesomelas* (Licht.). ♂, Calcasieu Parish, Louisiana. (No. 99969, U. S. Nat. Mus.)



SKULLS OF CHINCHA.

1, 2. *Chincha hudsonica.* 3, 4. *Chincha mesomelas.*

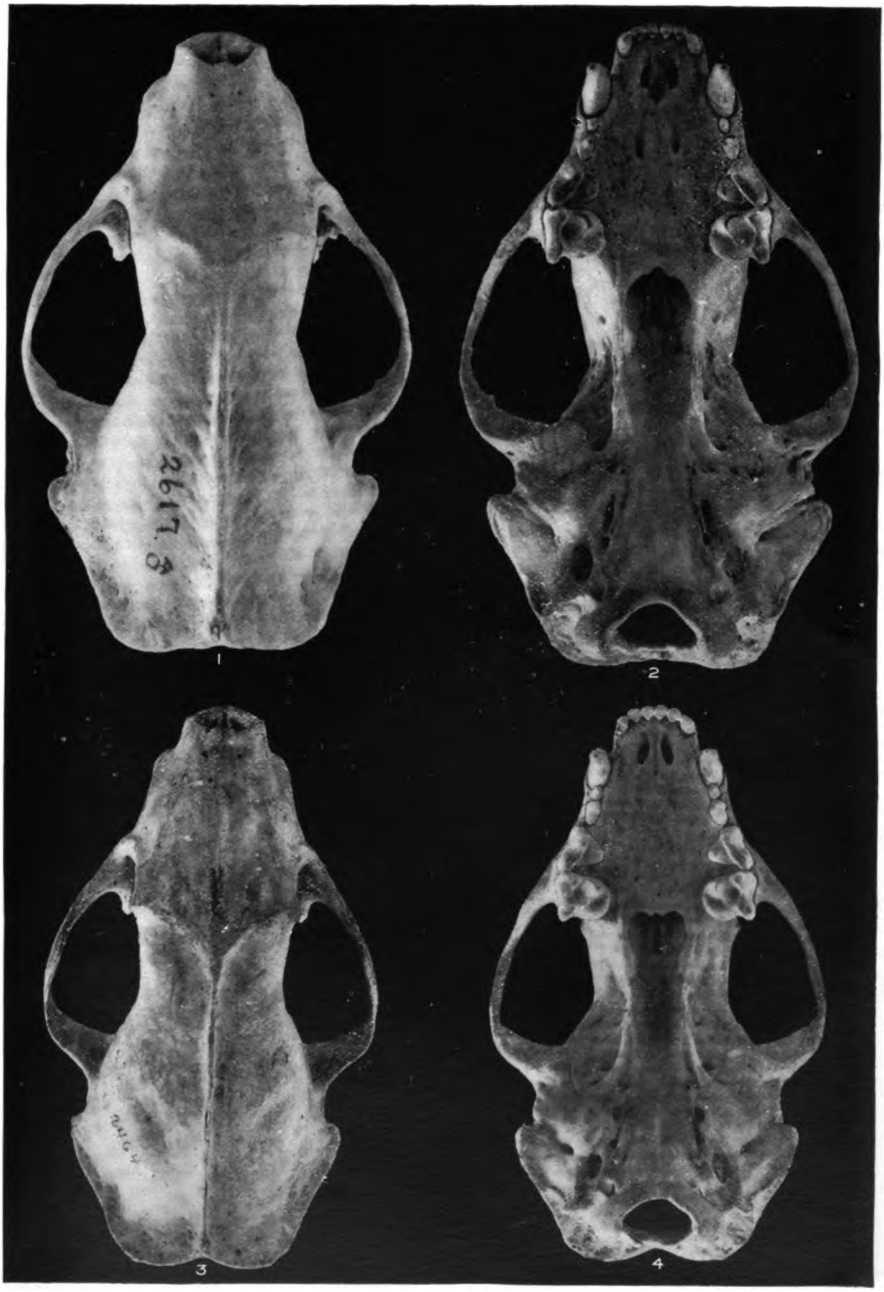
PLATE VII.

[Natural size.]

FIGS. 1 and 2. *Chincha occidentalis* (Baird). ♂, Type. Petaluma, California. (No. 2617, U. S. Nat. Mus.)

3 and 4. *Chincha estor* (Merriam). ♂, Type. San Francisco Mountain, Arizona. (No. 24645, U. S. Nat. Mus.)

PLATE VII.



SKULLS OF CHINCHA.

1, 2. *Chincha occidentalis.*   3, 4. *Chincha estor.*

PLATE VIII.

[Natural size.]

FIGS. 1 and 2. *Chincha* (*Leucomitra*) *macroura milleri* (Mearns). ♂, Fort Grant, Arizona. (No. 96129, U. S. Nat. Mus.)

3 and 4. *Chincha* (*Leucomitra*) *macroura vittata* (Licht.) ♂, San Mateo del Mar, Oaxaca. (No. 73478, U. S. Nat. Mus.)

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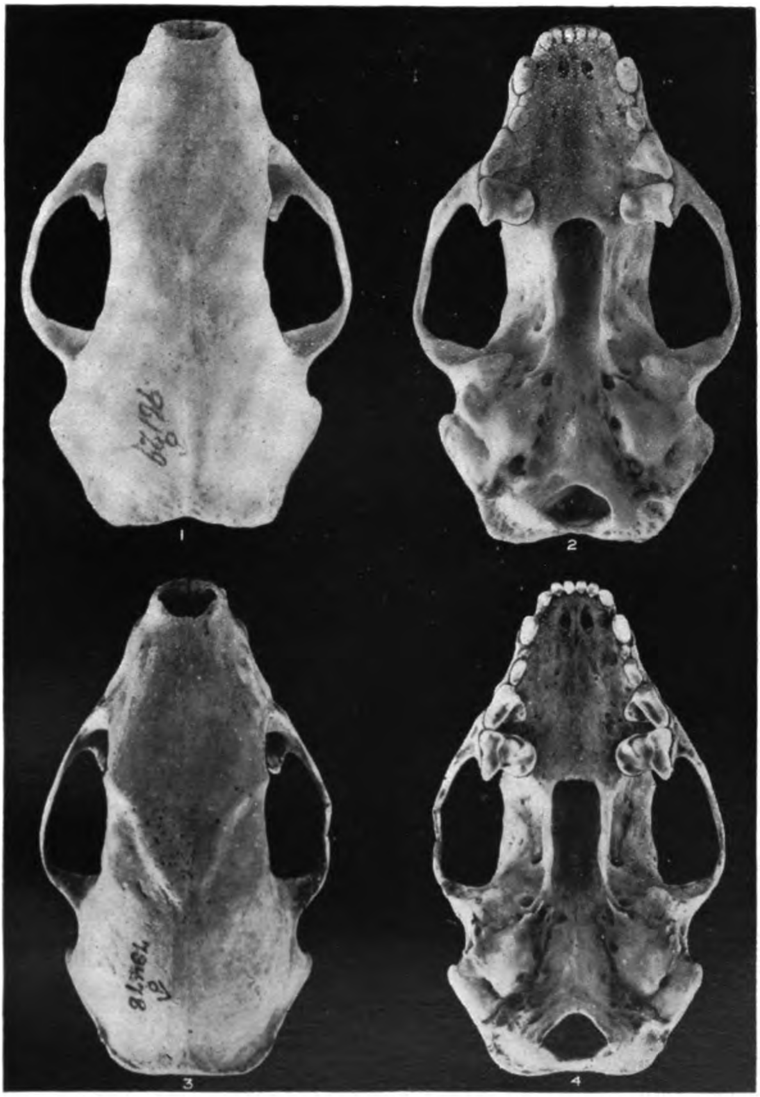

SKULLS OF CHINCHA (LEUCOMITRA).

1, 2. *Chincha macroura milleri.* 3, 4. *Chincha macroura vittata.*

U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 15

[Actual date of publication, August 8, 1899]

REVISION OF THE JUMPING MICE OF THE GENUS ZAPUS

BY

EDWARD A. PREBLE
ASSISTANT IN BIOLOGICAL SURVEY

Prepared under the direction of
Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

1862 1889

WASHINGTON
GOVERNMENT PRINTING OFFICE
1899

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NORTH AMERICAN FAUNA

No. 16

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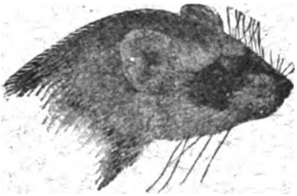

RESULTS OF A BIOLOGICAL SURVEY OF MOUNT SHASTA CALIFORNIA

BY

C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

WASHINGTON
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1899

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REVISION OF AMERICAN VOLES OF THE GENUS MICROTUS

BY

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CHIEF FIELD NATURALIST

Prepared under the direction of
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CHIEF OF DIVISION OF BIOLOGICAL SURVEY

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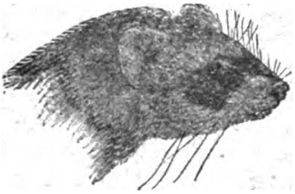

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General Account of the Region
Annotated List of Mammals
By WILFRED H. OSGOOD

Annotated List of Birds
By LOUIS B. BISHOP, M. D.

Prepared under the direction of
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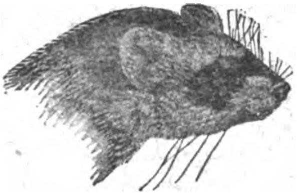

REVISION OF THE SKUNKS OF THE GENUS CHINCHA

BY

ARTHUR H. HOWELL
ASSISTANT, BIOLOGICAL SURVEY.

Prepared under the direction of
Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

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